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An Evaluation of the Effectiveness of U.S. Army Enlistment Bonuses

Volume I

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K. D. Midlam, Principal Analyst

Assisted by:

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Prepared for:

The Assistant Secretary of Defense
(Manpower and Reserve Affairs)

Contract No. MDA 903 75 C 204

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similar cohorts of bonus and non-bonus enlistees; the cost-effectiveness of the enlistment bonus when compared to increasing basic pay, recruiting and advertising; and the cost-effectiveness of the bonus as a method of increasing the average term of enlistment.

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CONTENTS

	<u>PAGE</u>
SUMMARY	S-1
Objectives of the Study	S-1
Background on Enlistment Bonuses	S-1
Effects of Enlistment Bonuses on Accessions	S-3
First Term Attrition and Expected Service Time	S-6
Losses from Combat Arms to Other Skills in the Army	S-11
Cost Effectiveness Analysis	S-22
Summary of Principal Findings	S-25
Policy Recommendations	S-27
Requirements for Additional Study	S-28
 1 THE EFFECT OF THE COMBAT ARMS ENLISTMENT BONUSES ON ARMY HIGH SCHOOL GRADUATE ACCESSIONS	
Objective	1-1
Background	1-1
Methodology	1-3
Conclusions	1-7
Other Significant Results	1-11
 2 THE EFFECT OF THE NON-COMBAT ARMS ENLISTMENT BONUS ON ARMY ACCESSIONS	
Objective	2-1
Background	2-1
Methodology	2-1
General Results	2-5
Conclusions	2-8
 3 LOSS RATE AND CONTINUATION RATE ANALYSIS FOR FIRST TERM ENLISTEES	
Objective	3-1
Methodology	3-1
Results of the Analysis	3-4

4	ANALYSIS OF LOSSES FROM COMBAT ARMS TO OTHER ARMY SKILLS	4-1
	Objective	4-1
	Background	4-1
	Methodology	4-1
	Analysis of Results	4-2
5	COST EFFECTIVENESS CONSIDERATIONS IN THE EVALUATION OF ENLISTMENT BONUSES	5-1
	Objective	5-1
	Measures of Effectiveness	5-1
	Combat Arms Enlistment Bonus	5-3
	Non-Combat Arms Enlistment Bonus	5-6

FIGURES

S1.	Sources and Dispositions of Combat Arms High School Graduate Enlistees When the \$1500 Enlistment Bonus Was Offered	S-4
S2.	Continuation Function for Service in Combat Arms Mental Group I-IIIA, High School Diploma Graduates Four Year Term, Other Than Europe Option	S-14
S3.	Continuation Function for Service in Combat Arms Mental Group I-IIIA, High School Diploma Graduates Three Year Term, Other Than Europe Option	S-15
S4.	Continuation Function for Service in Combat Arms Mental Group I-IIIA, High School Diploma Graduates Four Year Term, Europe Option	S-16
S5.	Continuation Function for Service in Combat Arms Mental Group I-IIIA, High School Diploma Graduates Three Year Term, Europe Option	S-17
S6.	Status of Enlistees with Combat Arms Options 30 Months After Enlistment High School Diploma Graduates, Three Year Enlistees with Other Than Europe Option	S-18
S7.	Status of Enlistees with Combat Arms Options 30 Months After Enlistment High School Diploma Graduates, Three Year Enlistees with Europe Option	S-19
S8.	Status of Enlistees with Combat Arms Options 30 Months After Enlistment High School Diploma Graduates, Four Year Enlistees with Europe Option	S-20
S9.	Status of Enlistees with Combat Arms Options 30 Months After Enlistment High School Diploma Graduates, Four Year Enlistees with Other Than Europe Option	S-21

<u>FIGURES</u>	<u>PAGE</u>
1. Ridge Trace, AHS3YR	1-6
2. Sources and Dispositions of Combat Arms High School Graduate Enlistees When the \$1500 Enlistment Bonus Was Offered	1-12
3. High School Graduate Improvement vs First Term Manning \$1500 Skills	2-4
4. High School Graduate Improvement Factors vs Pre-bonus Accessions \$2500 Skills	2-7
5. Months of Service	3-2
6. Monthly Loss Rates from Combat Arms to a Non-Combat Arms PMOS White, High School Graduates, Other than Europe Option	4-3
7. Monthly Loss Rates from Combat Arms to a Non-Combat Arms PMOS White, High School Graduate, Europe Option	4-4
8. Monthly Loss Rates from Combat Arms to a Non-Combat Arms PMOS White, High School Graduate, Four Year Enlistees	4-5
9. Monthly Loss Rates from Combat Arms to a Non-Combat Arms PMOS High School Graduates, Four Year Term Other Than Europe Option	4-6
10. Monthly Loss Rates from Combat Arms to a Non-Combat Arms PMOS White, High School Graduate, Three Year Term	4-7
11. Monthly Loss Rates from Combat Arms to a Non-Combat Arms PMOS High School Graduate, Three Year Term Other Than Europe Option	4-8
12. Monthly Loss Rates from Combat Arms to a Non-Combat Arms PMOS High School Graduate, Black Other Than Europe Option	4-9
13. Loss Rates from Combat Arms to Non-Combat Arms Duty MOS White, High School Graduate, Europe Option	4-13
14. Loss Rates from Combat Arms to Non-Combat Arms Duty MOS White, High School Graduates, Four Year Term	4-14
15. Loss Rates from Combat Arms to Non-Combat Arms Duty MOS White, High School Graduates, Three Year Term	4-15
16. Loss Rates from Combat Arms to Non-Combat Arms Duty MOS High School Graduates, Four Year Enlistees Other Than Europe Option	4-16

FIGURESPAGE

17. Loss Rates from Combat Arms to Non-Combat Arms Duty MOS High School Graduates, Three Year Term Other Than Europe Option	4-17
18. Loss Rates from Combat Arms to Non-Combat Arms Duty MOS Black High School Graduates Other Than Europe Option	4-18
19. Continuation Function for Service in Combat Arms Mental Group I-III A, High School Diploma Graduates Four Year Term, Other Than Europe Option	4-19
20. Continuation Function for Service in Combat Arms Mental Group I-III A, High School Diploma Graduates Three Year Term, Other Than Europe Option	4-20
21. Continuation Function for Service in Combat Arms Mental Group I-III A, High School Diploma Graduates Four Year Term, Europe Option	4-21
22. Continuation Function for Service in Combat Arms Mental Group I-III A, High School Diploma Graduates Three Year Term, Europe Option	4-22
23. Status of Enlistees with Combat Arms Options 30 Months After Enlistment High School Diploma Graduates, Three Year Enlistees with Other Than Europe Option	4-23
24. Status of Enlistees with Combat Arms Options 30 Months After Enlistment High School Diploma Graduates, Three Year Enlistees with Europe Option	4-24
25. Status of Enlistees with Combat Arms Options 30 Months After Enlistment High School Diploma Graduates, Four Year Enlistees with Europe Option	4-25
26. Status of Enlistees with Combat Arms Options 30 Months After Enlistment High School Diploma Graduates, Four Year Enlistees with Other Than Europe Option	4-26

TABLES

S1. Quality Distribution of Combat Arms and All NPS Male Enlistees	S-5
S2. Loss Rates at Four and Twelve Months All Enlistment Options by Education/Mental Group	S-8
S3. Loss Rates at Four and Twelve Months High School Diploma Graduates Mental Groups I-III A	S-9
S4. Expected Service Time All Enlistment Options By Education/Mental Group	S-9

<u>TABLES</u>	<u>PAGE</u>
S5. Expected Service Time High School Diploma Graduates/Mental Group I-IIIA, Combat Arms by Location Option All Accession Groups Combined	S-10
S6. Estimated Reenlistment Rates Expressed as a Percent of Original Enlistees High School Diploma Graduates	S-10
S7. Primary MOS Loss Rates from Combat Arms June 1972 Through February 1973 Enlistees Status as of June 30, 1975, High School Graduates	S-11
S8. PMOS Conditional Monthly Loss Rates High School Diploma Graduates Combat Arms Enlistees	S-12
S9. DMOS Monthly Loss Rates High School Diploma Graduates Combat Arms Enlistees	S-13
S10. Expected Service Times in Combat Arms High School Diploma Graduates Combat Arms Enlistment Options	S-22
S11. Cost Per Additional Expected Service Year in the Army by Mental Group I-III High School Graduates	S-23
S12. Cost Per Additional Expected Service Year in Combat Arms by Mental Group I-III High School Graduates	S-23
S13. Comparison of Costs Per Useful Service Year for Three and Four Year Enlistments in Combat Arms Skills	S-24
S14. Comparison of Costs Per Useful Service Year for Three and Four Year Enlistments for Non-Combat Arms Skill Offering a \$2500 Bonus	S-25
1. Combat Arms Bonus Enlistees, High School Diploma Graduates (True Volunteers)	1-2
2. Regressor Variables	1-5
3. Comparison of Ridge Regression Results	1-8
4. Manpower Prediction Model	1-9
5. Quality Distribution of Combat Arms and All NPS Male Enlistees	1-10
6. Mean Elasticities of the Accessions Groups Relative to Certain Independent Variables	1-13
7. Non-Combat Arms MOSSs with Bonus Offered - June-December 1974	2-2
8. Percent Improvement in High School Graduate Accessions	2-3

<u>TABLES</u>	<u>PAGE</u>
9. First Term Manning Levels	2-3
10. Percent Improvement in High School Graduate Accessions Black Accessions Versus Total Accessions	2-8
12. Loss Rates at Four and Twelve Months All Enlistment Options by Education/Mental Group	3-6
13. Loss Rates at Four and Twelve Months High School Diploma Graduates Mental Groups I-III A	3-7
14. Loss Rates at Four and Twelve Months High School Diploma Graduates Mental Groups I-III A Combat Arms Versus Non-Combat Arms	3-8
15. Generalized Monthly Loss Rates	3-9
16. Expected Service Time All Enlistment Options by Education/Mental Group (Continuation Rates Summed Over First 48 Months)	3-10
17. Expected Service Time High School Diploma Graduates/Mental Group I-III A, Combat Arms by Location Option All Accession Groups Combined	3-12
18. Expected Service Time High School Diploma Graduates/Mental Group I-III A, Combat Arms Versus Non-Combat Arms	3-12
19. Primary MOS Loss Rates from Combat Arms June 1972 Through February 1973 Enlistees Status as of June 30, 1975, High School Diploma Graduates	4-10
20. PMOS Conditional Monthly Loss Rates High School Diploma Graduates Combat Arms Enlistees	4-12
21. DMOS Monthly Loss Rates High School Diploma Graduates Combat Arms Enlistees	4-12
22. Expected Service Times in Combat Arms High School Diploma Graduates Combat Arms Enlistment Options	4-27
23. Cost Per Additional Expected Service Year in the Army by Mental Group I-III High School Graduates	5-4
24. Cost Per Additional Expected Service Year in Combat Arms by Mental Group I-III High School Graduates	5-5
25. Comparison of Costs Per Useful Service Year for Three and Four Year Enlistments in Combat Arms Skills	5-6
26. Cost Per Additional Expected Service Year in the Bonus Skills by Mental Group I-III High School Graduates \$2500 Bonus Skills	5-7
27. Comparison of Costs Per Useful Service Year for Three and Four Year Enlistments for Non Combat Arms Skill Offering a \$2500 Bonus	5-8

SUMMARY

OBJECTIVES OF THE STUDY

The purpose of this study was to evaluate the Army's enlistment bonus programs by analyzing four facets of the incentive:

- o The accession supply effects of the bonus on specific bonus skills with overall Army enlistments.
- o The retention behavior of bonus recipients relative to non-bonus recipients for demographically similar cohorts.
- o The extent of losses from combat arms to other skills for demographically similar cohorts of bonus and non-bonus enlistees.
- o The cost-effectiveness of the enlistment bonus when compared to increasing basic pay, recruiting and advertising; and the cost-effectiveness of the bonus as a method of increasing the average term of enlistment.

BACKGROUND ON ENLISTMENT BONUSES

Since FY72, Army has been paying a bonus to NPS males who successfully complete training in a combat arms MOS. Initially, a \$1500 bonus was paid to all entrants who enlisted for four years regardless of their mental group or level of education. In May 1973 the bonus amount was increased to \$2500 and offered only to high school graduates in mental group I-IIIa. While Army is now authorized to pay enlistment bonuses to other fields, the combat arms bonus option remains unchanged since its May 1973 modifications.

In converting to a Volunteer Force, both Army and OSD (M&RA) recognized that the combat arms field would be the most difficult to fill with adequate volunteers. To improve the drawing power of the skill and compensate volunteers for what was perceived to be an unattractive

occupation due to the rigorous physical demands and low payoff in skill adaptability to civilian employment, the cash bonus was offered. Army's original strategy was to offer a \$3000 bonus for a three year enlistment into the combat arms. In deliberations within DOD, this strategy was subsequently modified by reducing the level of payment and extending the term of enlistment by one year. Apparently, the changes to Army's original strategy were introduced to improve the "cost-effectiveness" of the option.

At the start of FY75, Army offered enlistment bonuses for four year enlistments in 25 non-combat arms skills. Fifteen of these skills were given a \$1500 bonus and ten a \$2500 bonus. These bonuses were also offered only to mental group I-III high school graduates. Primarily because of an increased supply of volunteers presumed arising from the general deterioration in the economic climate of the nation, a review of all accession programs was conducted by OASD (M&RA). As a result of this review and in light of the accession gains already realized in these skills, 17 of the original 25 non-combat bonus skills were eliminated from the bonus program in March 1975 and the remaining eight were restricted to \$1500 bonus levels.

The Army enlistment bonus program for FY76 has undergone several funding changes since the original President's budget level of \$64.7 million. As pointed out in the preceding paragraph, in March the program was reduced to \$55.6 million and in December 1975, House-Senate Conferencees have recommended \$53 million for the program. The Conferencees also agreed that this program level should not be considered a ceiling and the Army may, if it becomes necessary, apply additional funds from total enacted resources, provided the appropriate committees are notified. Army has expressed some doubt about the adequacy of the funding level and the possibility exists that it could not meet its bonus commitments for FY1976 at the \$53 million dollar level. This issue has not yet been resolved.

For FY1977, the enlisted bonus program has been more than cut in half from the \$53 million in FY1976 to \$24.7 million. As of this point in time, GRC is unaware of any detailed plan covering eligible bonus skills or levels of payment for FY1977.

EFFECTS OF ENLISTMENT BONUSES ON ACCESSIONS

Effect of the Combat Arms Bonus on Accessions to the Army

The results of a time series regression analysis covering the period January 1971-December 1974 indicate that the \$1500 combat arms enlistment bonus increased accessions of mental group I-III high school diploma graduates by 220-270 per month. This is a 6 to 7 percent increase over the true volunteer accessions of this quality group in the pre-bonus period. The analysis also indicates that the monthly gains due specifically to the bonus were constant over time and that later increases in monthly bonus enlistments could be accounted for by increases in recruiters and unemployment. Relative to the higher overall supply in FY76, the offering of the \$1500 bonus accounts for about 3 1/2 percent of the mental group I-III high school diploma graduates accessions to the Army.

The \$1000 increment in the combat arms enlistment bonus is estimated to have had no effect on overall accessions but does cause about 110 enlistees per month to choose four year rather than three year enlistments.

Effects of the Combat Arms Bonus on Accessions in Combat Arms

The 220-270 additional accessions per month gained by the Army because of the \$1500 bonus are necessarily combat arms enlistees. The average monthly high school diploma graduate accessions in combat arms prior to the bonus was 1450, so that the supply of combat arms enlistees of this quality group was apparently increased by 17 percent. Analysis of the actual time series for high school graduate combat arms accessions shows that neither the \$1500 bonus nor the \$1000 increase had any effect on accessions. It must be inferred, therefore, that the 250 new accessions were used to replace an equal number of lower quality enlistees who were enlisted in other skills. The overall effect of the \$1500 bonus on high school graduate combat arms accessions is shown in Fig. S.1.

Since data were not available to allow analysis of combat arms accessions by mental group, it is not possible to prove conclusively the inference of the substitution of higher quality for lower quality enlistees associated with the bonus. It has been generally accepted, however, that prior to the bonus the mental group IV content of combat arms enlistees was higher than for all enlistees in the Army. It can also be

NO BONUS (all 3 year HSG enlistees)

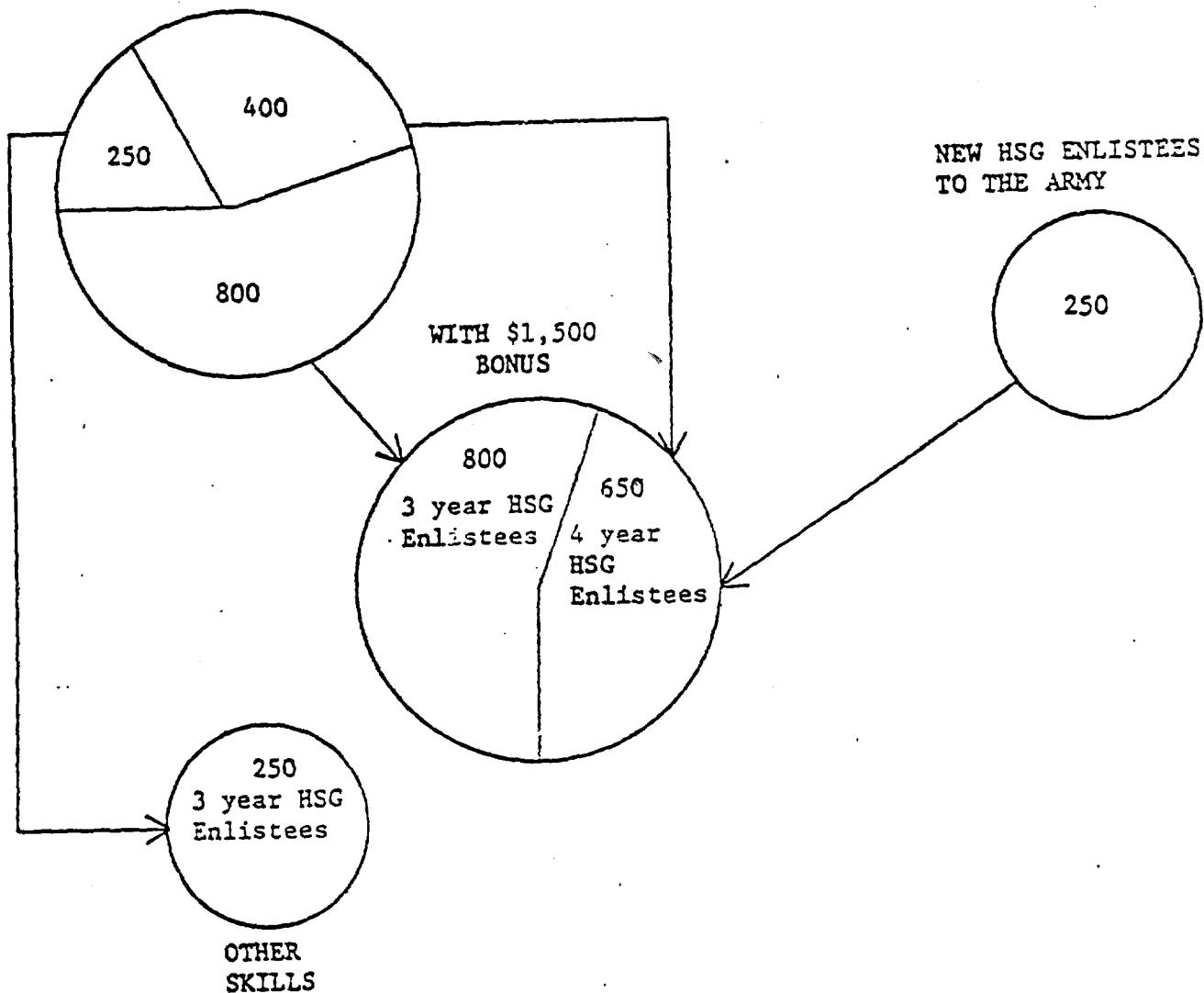


Fig. S1—Sources and Dispositions of Combat Arms High School Graduate Enlistees When the \$1500 Enlistment Bonus Was Offered

seen in Table S1 that in most time periods after the introduction of the bonus the quality distribution of combat arms enlistees has been equal to or more favorable than the distribution of all enlistees.

Table S1
QUALITY DISTRIBUTION OF COMBAT ARMS
AND ALL NPS MALE ENLISTEES

	FY73		FY75	
	Combat Arms	All NPS Male	Combat Arms	All NPS Male
Mental Group I-III	84%	83%	91%	89%
Mental Group IV	16%	17%	7%	11%
High School Diploma	44%	52%	51%	54%
GED's	5%	6%	13%	8%
Blacks	19%	21%	19%	23%

Effects of the Non-Combat Arms Enlistment Bonus on Accessions to the Army

Using time series methods similar to those discussed in preceding sections, it is concluded that the mix of non-combat arms skills bonuses offered between June 1974 and February 1975 increased high school graduate accessions to the Army by about 150, or 2% per month. These bonuses also drew about 100 enlistees per month away from combat arms.

Effects of the Non-Combat Arms Enlistment Bonus on Accessions to the Bonus Skills

The bonuses offered to the twenty-five non-combat arms skills increased high school graduate accessions to these skills by 250-300 per month.

The gains in the individual skills were highly variable. The ten skills offering \$2500 bonuses showed an increase in high school graduate accessions of 115 percent, while the fifteen skills offering \$1500 bonuses showed a gain of only 14 percent. Clearly, offering \$1500 bonuses for a skill will not significantly increase accessions to that skill when \$2500 bonuses are being offered in related skills.

The percentage gains in high school graduate accessions for the \$2500 skills is shown, in Chapter 2, to be inversely related to the number of high school graduate accessions expected without the bonus.

That is, a skill with a large number of accessions in the no-bonus period will show a much smaller percentage improvement than will a skill with a small no-bonus accessions expectation. More concretely, the relationship

$$P = 2400/\sqrt{A} \quad (S1)$$

is shown to be applicable in Chapter 2, where P is the percentage gain in high school graduate accessions and A is the expected number of annual accessions if no bonus is offered.

FIRST TERM ATTRITION AND EXPECTED SERVICE TIME

The enlistment bonuses are paid only for a four year commitment. Several factors can combine to reduce the apparent additional year gained in practice. Differences in loss patterns between three and four year enlistees and substantial reenlistment rates by three year enlistees will materially reduce the realized gain in service time obtained with the longer initial commitment.

For this study, over 500,000 volunteer enlistees with accession dates between January 1971 and March 1975 were analyzed to determine loss rates and reenlistment rates by month of service. Using the loss rates it was possible to construct continuation functions over time and by summing the continuation functions over time, to obtain estimates of expected service times.

Because of the size of the data base it was possible to classify the enlistees by several factors: race, term of enlistment, enlistment option and various education/mental group classifications. In addition, the analysis was carried out separately for enlistees with accession dates prior to July 1973 and with accession dates of July 1973 and later. The two accession groups were also combined in a separate analysis.

General Results

The analysis yielded several obvious and consistent differences in loss rates and patterns among various categories of enlistees.

1. High school diploma graduates have significantly lower losses over the entire first term than do GEDs and other non-high school graduates. There is little difference between GEDs and other non-high school graduates.
2. Loss rates for blacks are usually lower than for similar non-blacks.

3. Loss rates for mental group IV high school graduates are slightly higher than mental group I-III high school graduates, but significantly lower than those for non-high school graduates.

4. There is little difference in loss rates between pre-FY74 enlistees and the more recent enlistees. Loss rates in the very early months are slightly lower for the pre-FY74 group, but by the second year of service there is little practical difference.

First Year Loss Rates

Almost without exception the loss rates in the first year of service are higher than at any other time (excepting ETS-like losses). It is also in the first year that the greatest differences among the various groups appear. Tables S2 and S3 show the four month and twelve month loss rates for groups of particular importance to this study. One number here is especially important - the loss rate for four year combat arms enlistees (mental group I-III A high school graduates) through four months is 8 percent. That is, 8 percent of the bonus enlistees do not survive to the point of eligibility to actually receive the bonus.

Expected Service Times

To portray more graphically what differences in loss rates mean in terms of lost service and the impact on accession and training requirements, the continuation functions are converted to a numeric measure of expected service time. For this study, the expected service time is defined as the sum of the continuation rates over the first 48 months of service. This provides a uniform measure upon which an evaluation of the gain in service from the additional year of committed service can be based. For the categories whose early loss rates were shown in Table S2 and S3, values of the expected service time are given in Table S4 and S5.

As can be seen, on the average the gain in expected service time from the additional committed year is .35-.40 years for mental group I-III A high school graduates.

Table S2
LOSS RATES AT FOUR AND TWELVE MONTHS
ALL ENLISTMENT OPTIONS BY EDUCATION/MENTAL GROUP

Acc Group	Term	Race	HS			HS			GED			NHS		
			I-IIIA		IV	HS		AII	HS		AII	GED		NHS
			4 mo/12 mo											
7101/	3 yr	White	.06/.13		.10/.18			.07/.13				.14/.29		.11/.27
		Black	.05/.14		.05/.13			.05/.12				.10/.25		.07/.23
		All	.06/.14		.07/.14			.06/.13				.13/.28		.11/.26
	4 yr	White	.06/.11		.10/.20			.07/.13				.12/.24		.12/.31
		Black	.04/.11		.06/.14			.05/.11				.05/.21		.07/.23
		All	.06/.11		.08/.17			.06/.14				.11/.24		.11/.30
	7306	White	.08/.13		.14/.20			.09/.14				.16/.30		.19/.32
		Black	.07/.12		.08/.13			.07/.12				.12/.24		.14/.28
		All	.08/.13		.11/.16			.08/.14				.16/.29		.18/.31
7307/	3 yr	White	.08/.14		.10/.21			.09/.15				.15/.27		.12/.26
		Black	.05/.12		.04/.04			.05/.13				.12/.21		.15/.21
		All	.08/.13		.07/.13			.08/.14				.15/.27		.17/.24
7503	4 yr	White	.08/.14		.10/.21			.09/.15				.15/.27		.12/.26
		Black	.05/.12		.04/.04			.05/.13				.12/.21		.15/.21
		All	.08/.13		.07/.13			.08/.14				.15/.27		.17/.24

Table S3

LOSS RATES AT FOUR AND TWELVE MONTHS
 HIGH SCHOOL DIPLOMA GRADUATES MENTAL GROUPS I-III
 Combat Arms Versus Non-Combat Arms

		3 Yr Term		4 Yr Term	
		Combat Arms 4 mo/12 mo	Other 4 mo/12 mo	Combat Arms 4 mo/12 mo	Other 4 mo/12 mo
7101/	White	.07/.12	.06/.12	.07/.13	.04/.09
7306	Black	.05/.15	.05/.12	.04/.11	.06/.12
	All	.07/.12	.06/.12	.07/.12	.04/.09
7307/	White	.09/.13	.08/.13	.09/.14	.07/.13
7503	Black	.07/.14	.06/.12	.05/.12	.06/.09
	All	.09/.14	.08/.13	.08/.14	.07/.12

Table S4

EXPECTED SERVICE TIME
 ALL ENLISTMENT OPTIONS BY EDUCATION/MENTAL GROUP
 (CONTINUATION RATES SUMMED OVER FIRST 48 MONTHS)

Accession Group	Term	Race	HSI-III	HSIV	HS All	GED	NHS
71/01- 73/06	3	White	2.77	2.64	2.76	2.17	2.23
		Black	2.89	2.92	2.91	2.30	2.39
		All	2.80	2.80	2.80	2.19	2.27
73/04- 75/03	4	White	3.27	2.89	3.15	2.58	2.25
		Black	3.34	NA	3.25	2.62	2.64
		All	3.25	2.89	3.18	2.59	2.35
	3	White	2.76	2.60	2.75	2.08	2.02
		Black	2.84	2.79	2.81	2.24	2.34
		All	2.78	2.69	2.76	2.11	2.14
	4	White	3.23	3.06	3.22	2.66	2.49
		Black	3.31	NA	3.31	2.83	2.85
		All	3.25	3.06	3.24	2.70	2.66

Table S5
EXPECTED SERVICE TIME
HIGH SCHOOL DIPLOMA GRADUATES/MENTAL GROUP I-IIIA
COMBAT ARMS BY LOCATION OPTION
ALL ACCESSION GROUPS COMBINED
(CONTINUATION RATES SUMMED OVER FIRST 48 MONTHS)

Race	3 Year Term			4 Year Term		
	CA-Europe	CA-Conus	CA-All	CA-Europe	CA-Conus	CA-All
White	2.72	2.88	2.81	3.07	3.19	3.16
Black	2.82	3.01	2.88	3.23	3.29	3.28
All	2.72	2.89	2.81	3.10	3.24	3.21

Reenlistment Rates

This analysis has also provided some data on reenlistment rates for the various categories of enlistees. In the following, the reenlistment rates are expressed as fractions of original enlistees. Based on the data analyzed, reenlistment rates for high school graduates are estimated to be as shown in Table S6.

Table S6
ESTIMATED REENLISTMENT RATES EXPRESSED AS A PERCENT OF ORIGINAL ENLISTEES
HIGH SCHOOL DIPLOMA GRADUATES

Race	Mental Group	Term of Enlistment		
		Three Year	Four Year	Other
Combat Arms	Combat Arms	Other	Combat Arms	Other
White	I-IIIA	25%	24%	40%
	IIIB	28%	26%	45%
	IV	28%	26%	N/A
Black	I-IIIA	34%	36%	42%
	IIIB	39%	37%	48%
	IV	42%	39%	40%
				N/A

LOSSES FROM COMBAT ARMS TO OTHER SKILLS IN THE ARMY

The preceding sections discussed continuation rates and the differences in expected service times for various categories of enlistees. These data are for retention in the Army as a whole and do not measure directly continuation in the particular skill for which the bonus was offered.

Using the same gain and loss data which were used for the continuation rate analysis, an extract was taken which consisted of all combat arms enlistees whose accession dates were between June 1972 and October 1974. These records were matched against a modified June 30, 1975 enlisted master file to determine trends in shifts out of combat arms into other skills both at the primary MOS level and the duty MOS level.

Primary MOS Losses from Combat Arms

Table S7 summarizes the key results from this analysis of primary MOS (PMOS) losses. There are clear differences in the results for three and four year enlistees with the three year enlistees' PMOS loss rates being much higher. In addition, the PMOS loss rates for enlistees with the Europe option are much lower than for other combat arms enlistees. In general, only for Europe-option four year enlistees is there any substantial difference between reenlistees and non-reenlistees.

Table S7

PRIMARY MOS LOSS RATES FROM COMBAT ARMS JUNE 1972 THROUGH
FEBRUARY 1973 ENLISTEES STATUS AS OF JUNE 30, 1975
HIGH SCHOOL DIPLOMA GRADUATES

Race	Term of Enlistment	Have not reenlisted Option	Have not reenlisted		Have reenlisted	
			Europe	Other	Europe	Other
White	3		.122	.268	.100	.262
	4		.031	.059	.059	.078
Black	3		.173	.265	N/A	.219
	4		.036	.043	N/A	.051
All	3		.132	.268	.100	.249
	4		.032	.054	.059	.070

There is clear evidence that the PMOS losses from combat arms tend to increase over the term of service at a fairly constant monthly rate. The data of Table S7 can be converted into monthly (new) PMOS loss rates. These monthly estimated loss rates are shown in Table S8.

Table S8
PMOS CONDITIONAL MONTHLY LOSS RATES
HIGH SCHOOL DIPLOMA GRADUATES
COMBAT ARMS ENLISTEES

Race	Term of enlistment	Have not reenlisted		Have reenlisted	
		Europe	Other	Europe	Other
White	3	.004	.010	.003	.009
	4	.001	.002	.002	.002
Black	3	.005	.009	.004	.008
	4	.001	.001	.002	.002
All	3	.004	.010	.003	.009
	4	.001	.002	.002	.002

Duty MOS losses from Combat Arms

The results of the analysis of duty MOS (DMOS) losses are quite different from those for the PMOS losses. Rather than occurring at a constant monthly rate, a fixed percentage of those combat arms enlistees still in the Army with a combat arms PMOS are serving, at any point in time, in a non-combat arms duty MOS. The fractions of combat arms availables who have non-combat arms DMOSS at any point of time are shown in Table S9 for combinations of race, term, option and reenlistment status. As with PMOS losses, three year enlistees have higher DMOS losses and Europe-option enlistees have slightly lower DMOS losses.

Table S9
DMOS MONTHLY LOSS RATES
HIGH SCHOOL DIPLOMA GRADUATES
COMBAT ARMS ENLISTEES

Race	Term of Enlistment	Option	
		Europe	Other
White	3	.095	.120
	4	.070	.060
Black	3	.105	.105
	4	.090	.050
All	3	.097	.117
	4	.074	.058

Net Effect of Losses to the Army, to the Primary MOS and to the Duty MOS on Continuation in Combat Arms

The net effect of the three types of losses from combat arms can be summarized directly as modifications of the continuation rate function. Such modified continuation functions are shown in Figs. S2-S5 for three and four year enlistees with Europe and other than Europe options.

As a further amplification of these effects, Figs. S6-S9 show the expected status of combat arms enlistees 30 months after enlistment for the same four combinations of term of enlistment and enlistment option.

Expected Service Times in Combat Arms

The results reflected in Figs. S2-S5 can be translated directly into adjustments of the expected service times of Table S5. Taking into account both PMOS and DMOS losses, the expected service times in combat arms are as shown in Table S10. The gain in expected time in combat arms from the additional year committed by acceptance of the bonus is about .5-.8 years which is .15-.40 years greater than the difference in expected service times in the Army. This difference arises primarily because of the wide differences in PMOS loss rates between three and four year enlistees.

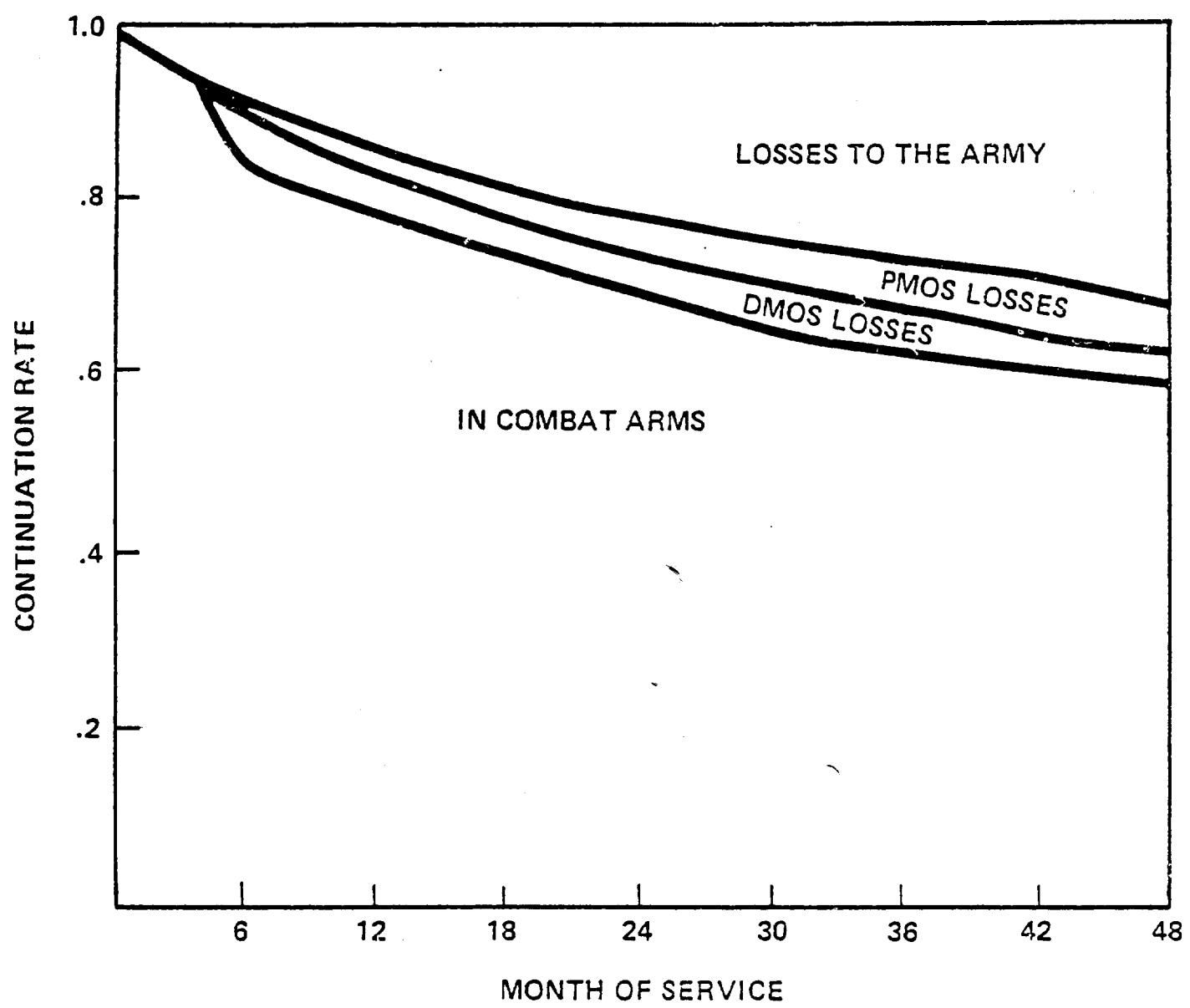


Fig. S2—Continuation Function for Service in Combat Arms
Mental Group I-III A, High School Diploma Graduates
Four Year Term, Other Than Europe Option

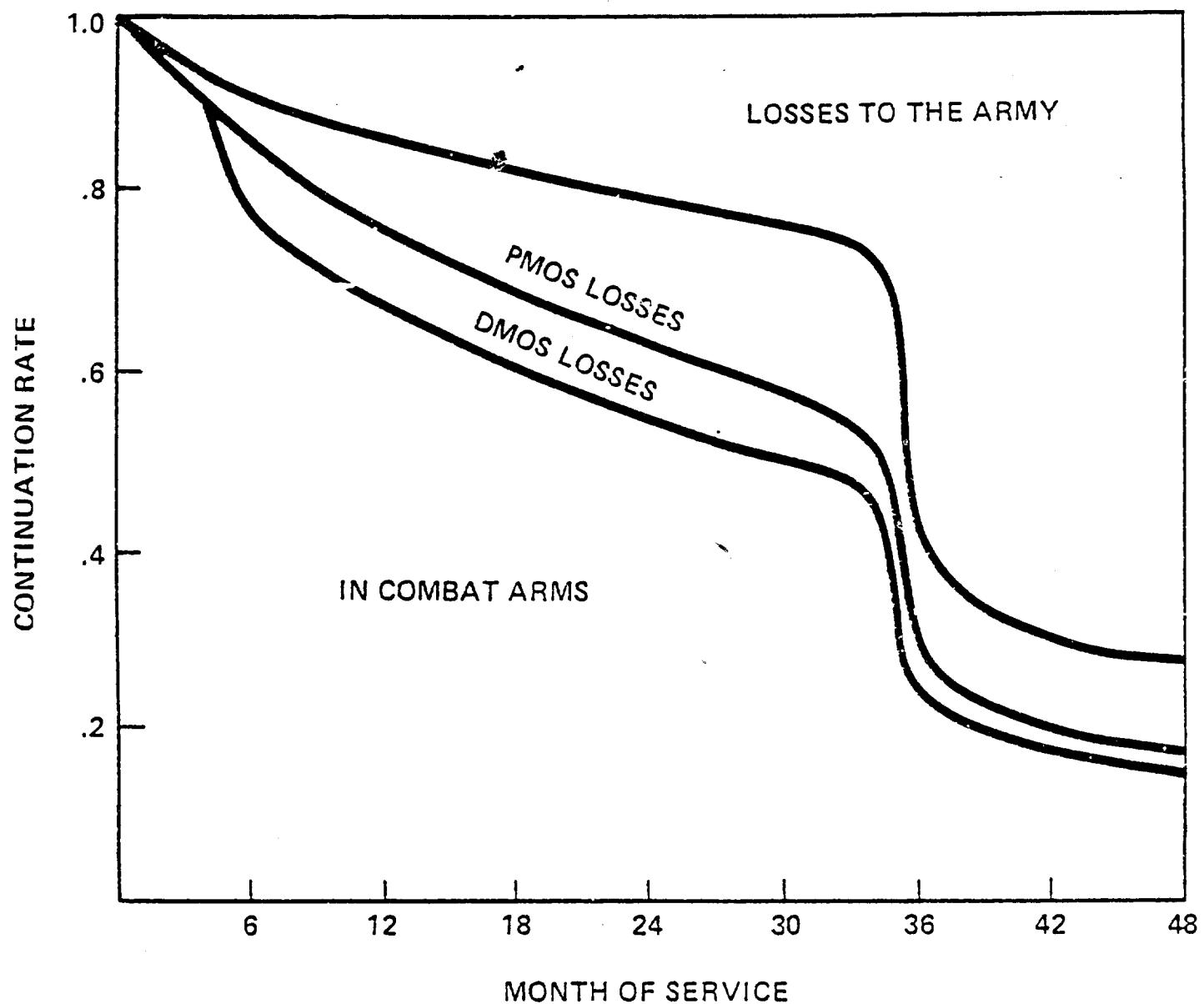


Fig. S3—Continuation Function for Service in Combat Arms
Mental Group I-IIIA, High School Diploma Graduates
Three Year Term, Other Than Europe Option

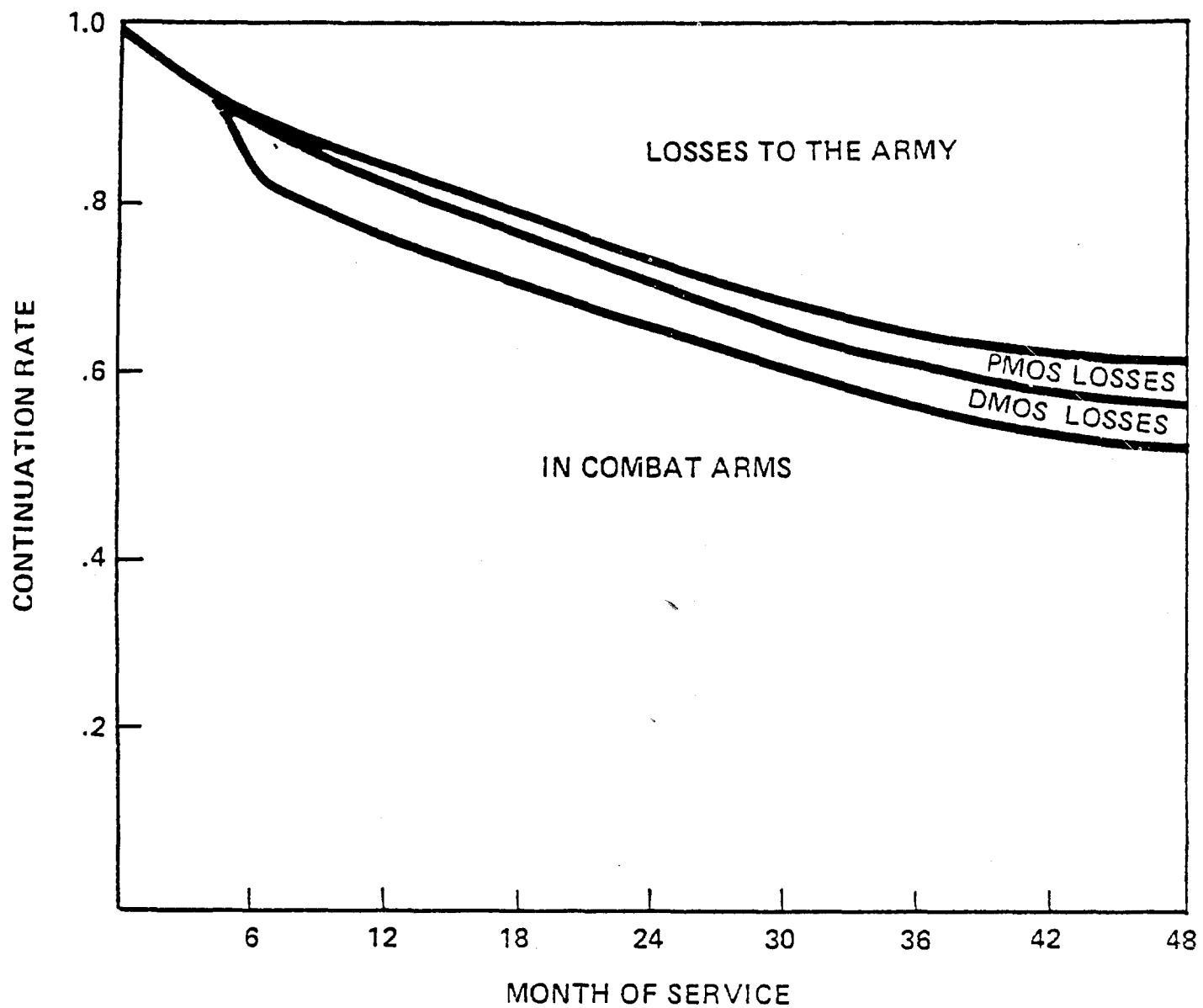


Fig. S4—Continuation Function for Service in Combat Arms
Mental Group I-III A, High School Diploma Graduates
Four Year Term, Europe Option

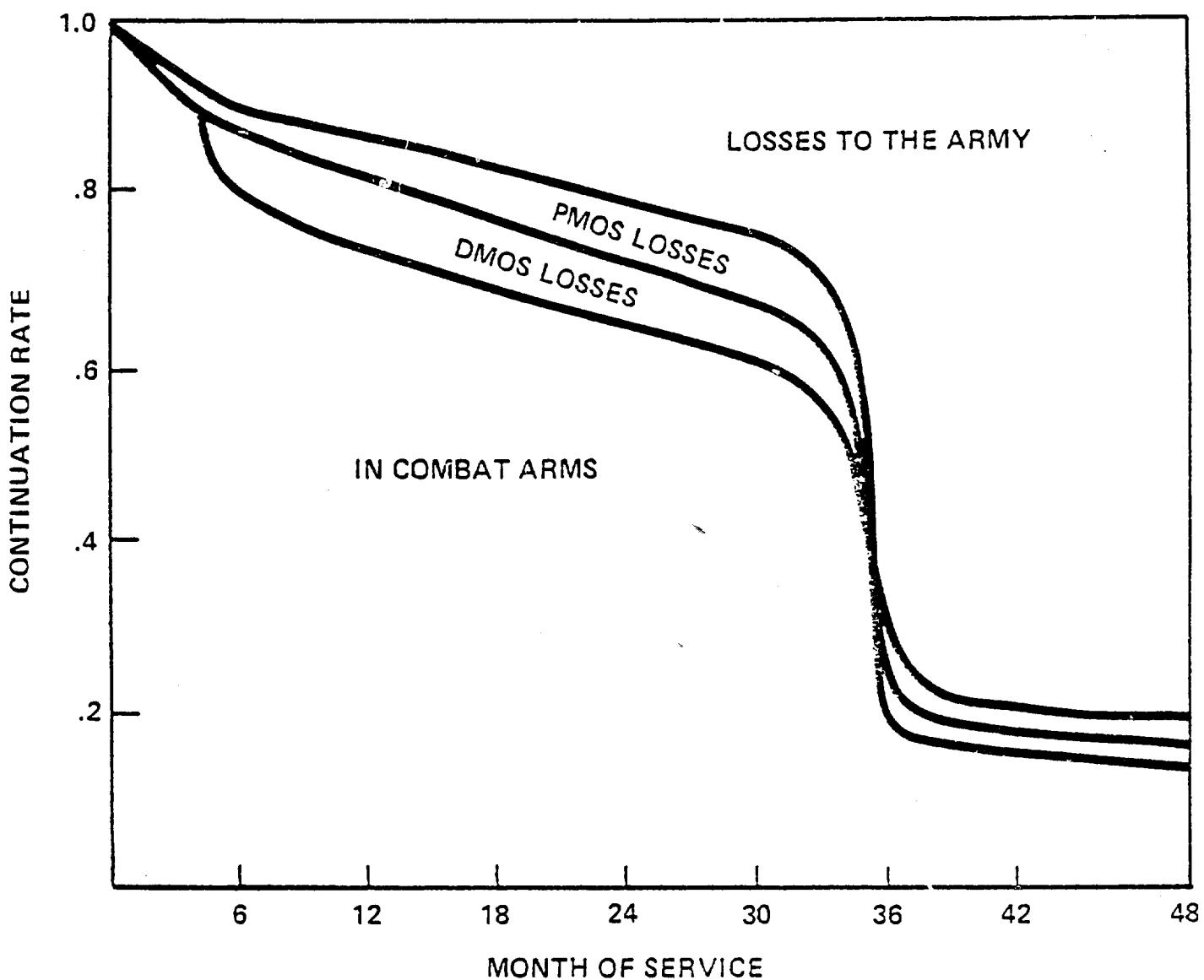


Fig. S5—Continuation Function for Service in Combat Arms
Mental Group I-IIIA, High School Diploma Graduates
Three Year Term, Europe Option

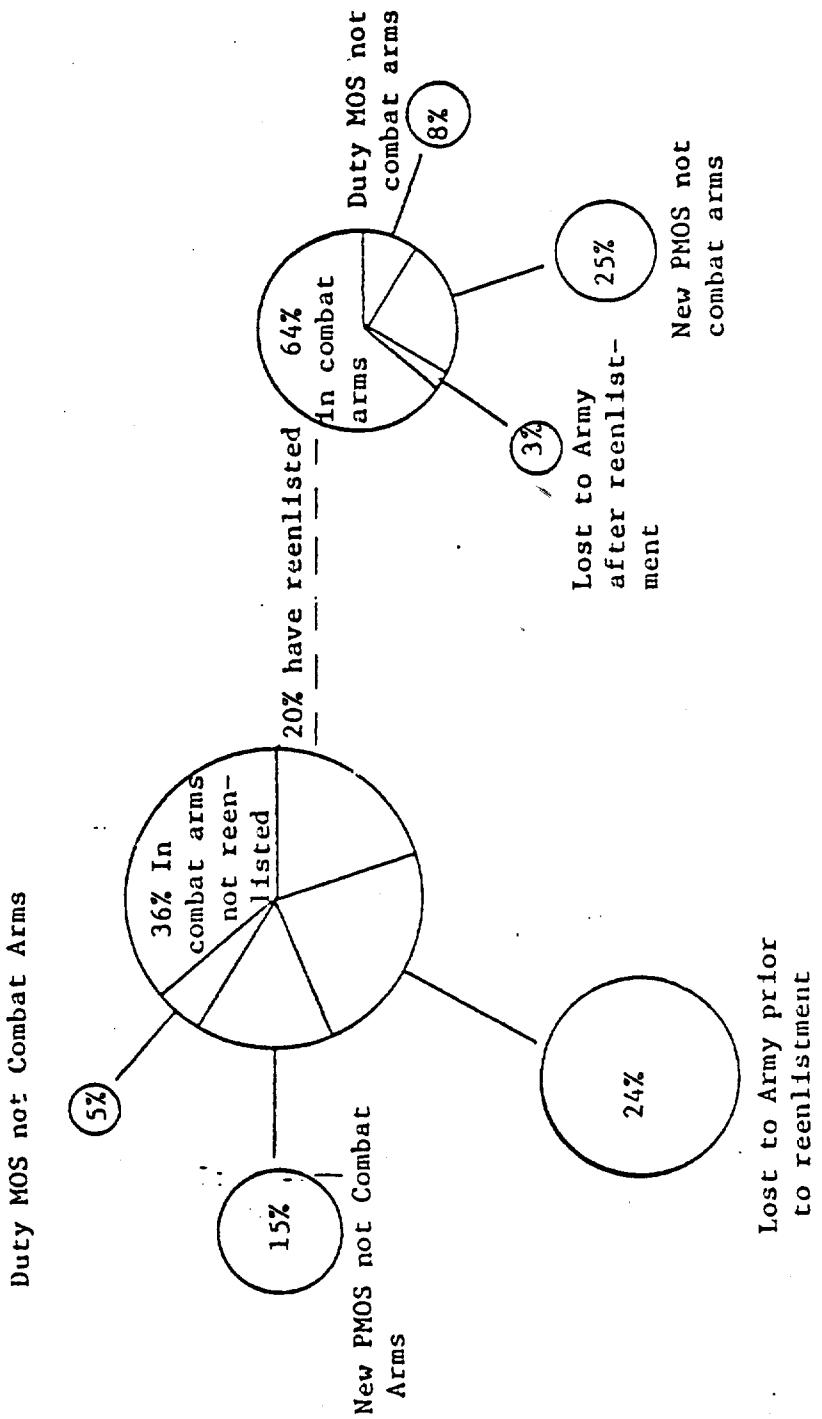


Fig. S6—Status of Enlistees with Combat Arms Options 30 Months After Enlistment
 High School Diploma Graduates,
 Three Year Enlistees with Other Than Europe Option

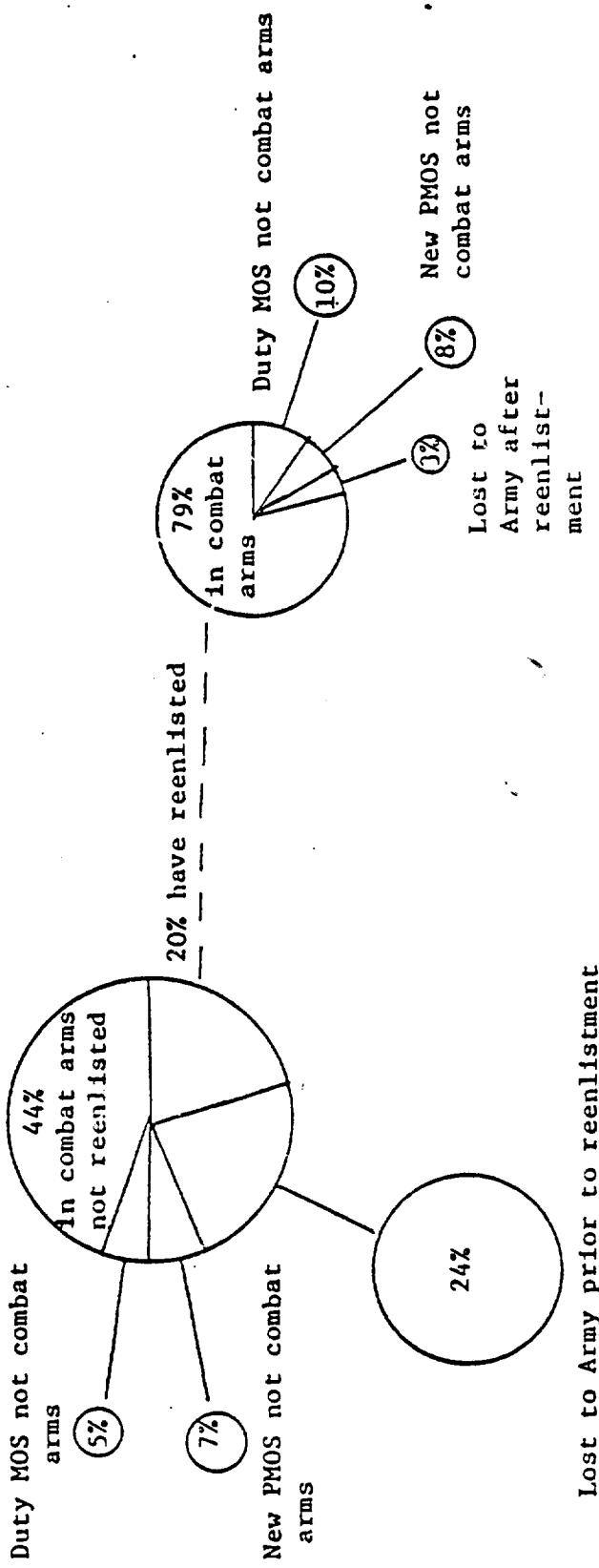


Fig. S7—Status of Enlistees with Combat Arms Options 30 Months After Enlistment
 High School Diploma Graduates,
 Three Year Enlistees with Europe Option

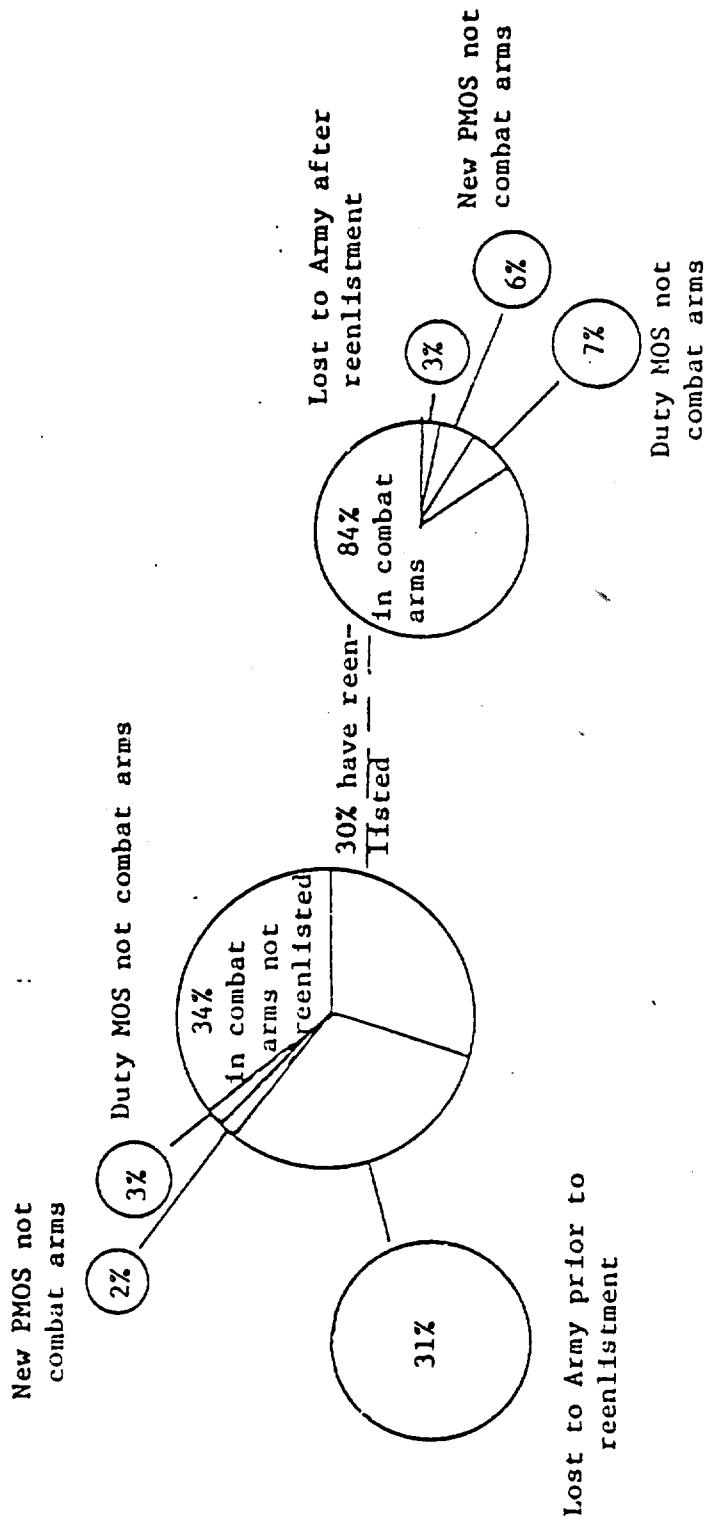


Fig. S8--Status of Enlistees with Combat Arms Options 30 Months After Enlistment
 High School Diploma Graduates,
 Four Year Enlistees with Europe Option

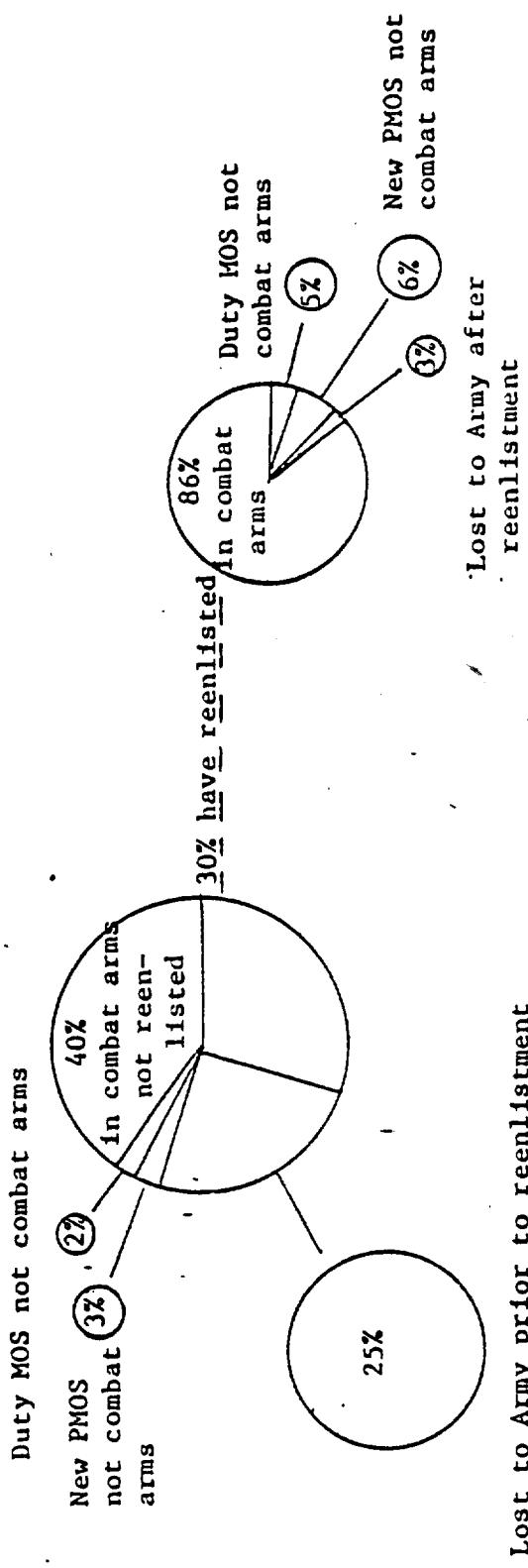


Fig. S9—Status of Enlistedees with Combat Arms Options 30 Months After Enlistment
 High School Diploma Graduates,
 Four Year Enlistedees with Other Than Europe Option

Table S10
 EXPECTED SERVICE TIMES IN COMBAT ARMS
 HIGH SCHOOL DIPLOMA GRADUATES
 COMBAT ARMS ENLISTMENT OPTIONS

Option	3 year term	4 year term
Europe	2.32	2.82
CONUS	2.11	2.93
All	2.22	2.86

COST EFFECTIVENESS ANALYSIS

By combining the results of the preceding sections it is possible to construct and evaluate two separate measures of cost effectiveness for the enlistment bonuses. One measure, defined as the "cost per useful service year" provides an evaluation of the cost (which may be negative) of paying a bonus to a three year enlistee to commit for an additional year. This measure is independent of any consideration of increases in accessions due to the bonus, and is useful in determining whether an enlistment bonus should be offered for the additional year, even when no actual increase in accession level is required. The cost per useful service year as defined in this study includes pay, accession, variable training and bonus costs and adjusts the expected service time by subtracting training time.

The second measure used is the "cost per additional service year" and is used to compare the cost of increasing the total expected service years to be gained by offering the bonus with the cost of similar gains that might be expected from increases in RMC pay, recruiting or advertising (which are assumed to increase the supply of three year enlistees).

As before, the analysis here is restricted to the preferred quality group - mental group I-III high school diploma graduates.

Combat Arms

Table S11 and S12 summarize the comparison of cost per additional expected service year in the Army and in combat arms, respectively. As expected, the marginal effectiveness of the \$1000 increase in the bonus is very low. On the other hand, the cost for the first \$1500 bonus is significantly lower than the estimated costs for increases in recruiting, advertising and RMC pay.

Table S11

COST PER ADDITIONAL EXPECTED SERVICE YEAR IN THE ARMY
BY MENTAL GROUP I-III HIGH SCHOOL GRADUATES

Program	Cost per additional expected service year
\$1500 Combat Arms Bonus	\$ 970
\$1000 Increase in Combat Arms Enlistment Bonus	\$18,685
Increase in Number of Recruiters	\$ 2,040
Increase in Advertising Budget	\$ 3,590
Increase in RMC Pay (Increased pay only for Army)	\$32,500

Table S12

COST PER ADDITIONAL EXPECTED SERVICE YEAR IN COMBAT ARMS
BY MENTAL GROUP I-III HIGH SCHOOL GRADUATES

Program	Cost per additional expected service year
\$1500 Combat Arms Bonus	\$ 1,135
\$1000 Increase in Combat Arms Enlistment Bonus	\$ 12,630
Increase in Number of Recruiters	\$ 5,680
Increase in Advertising Budget	\$ 9,995
Increase in RMC Pay (Increased pay only for Army)	\$224,175

Table S13 summarizes the cost per useful service year for the various combat arms PMOSs. As can be seen, only for the skill with highest training cost and longest training time (13E) does the \$1500 bonus reduce the average cost per year of useful service.

Table S13

COMPARISON OF COSTS PER USEFUL SERVICE YEAR FOR THREE AND FOUR YEAR ENLISTMENTS IN COMBAT ARMS SKILLS

Combat Arms MOS	Training time (years)	Variable* training cost	Cost per useful service year		
			3 year term	4 year \$1500 bonus	4 year \$2500 bonus
11B	.19	\$ 1,840	\$ 9,390	\$ 9,740	\$ 10,055
11C	.19	2,710	9,610	10,025	10,330
11D	.30	3,145	10,210	10,555	10,870
11E	.30	4,410	10,710	10,990	11,305
11F	.19	1,325	9,080	9,565	9,870
13B	.32	3,710	10,520	10,820	11,140
13E	.47	8,460	13,230	13,150**	13,485

* Excluding trainee pay.

** Cost per year for four year enlistment with \$1500 bonus is less than cost per year for three year enlistment.

In summary, with the exception of PMOS 13E, the \$1500 bonus cannot be justified on the expectation of a reduction in the cost per useful service year. On the other hand, the \$1500 bonus does increase the supply of enlistees both to the Army and to combat arms and does so at a marginal cost which is lower than the estimated marginal costs for increases in RMC pay, recruiting or advertising.

Non-Combat Arms

The cost per additional expected service year in the Army for the ten non-combat arms skills with \$2500 bonuses is \$845. The cost per additional expected service year in the skills varies from \$700-\$1000 depending on the expected improvement in accessions, as discussed in Chapter II. In any case, these costs are uniformly lower than the expected costs for increases in RMC pay, recruiting or advertising.

The cost per useful service year for these ten skills is compared in Table S14 for three and four year (with the bonus) enlistments. Here it is seen that several skills with high training cost and/or long training time would benefit from the additional service time gained with the bonus, even if no new accessions had been obtained.

Table S14

COMPARISON OF COSTS PER USEFUL SERVICE YEAR FOR THREE AND FOUR
YEAR ENLISTMENTS FOR NON COMBAT ARMS SKILL OFFERING A \$2500 BONUS

MOS	Training Time	Variable* Training Cost	Cost per useful service year	
			3 year term	4 year term
12B	.30	1880	\$ 9,980	\$ 10,405
15E	.32	4290	11,030	11,280
16P	.32	4350	11,055	11,300
16R	.32	3435	10,685	10,995
22L	.89	9190	16,855	15,960 **
27D	.32	2410	10,275	10,650
27H	.47	4510	11,830	11,950
32E	.99	10350	18,420	17,510 **
35J	.55	5340	12,615	12,600 **
46N	.78	5210	13,980	13,695 **

* Trainee pay excluded.

** Cost per year for four year enlistment with \$2500 bonus is less than cost per year for three year enlistment.

SUMMARY OF PRINCIPAL FINDINGS

- o The \$1500 combat arms enlistment bonus increased the supply of high school diploma graduates by 250 per month. This was a 17 percent increase in the supply available to combat arms. The actual high school graduate combat arms accessions did not increase; the new supply apparently replaced lower quality high school graduates who were diverted to other skills. This generally resulted in a more nearly uniform distribution of mental category IV enlistees over the combat arms and other skills in the Army.
- o The \$1000 increase in the combat arms enlistment bonus did not affect the supply of high school diploma graduates to the Army. It did cause an addition of 100-150 enlistees per month to enlist for the extra year.
- o The mix of enlistment bonuses offered for four years' service in certain non-combat arms skills increased high school graduate accessions

to the Army by 150 per month and drew an additional 100 per month away from combat arms. The effect of the \$2500 bonuses on high school graduate accessions in these skills varied from a gain of 15 percent in a "large" MOS (12B) to a gain of over 250 percent in some "small" MOSs. When \$2500 bonuses and \$1500 bonuses are offered in similar skills, the \$1500 bonus succeeds only in minimizing losses from those skills to the \$2500 bonus skills.

o About 8 percent of the bonus enlistees do not survive in the Army long enough to actually receive the bonus.

o The gain in expected service time to be achieved by offering the bonus and requiring a four year commitment is .35-.40 years for time in the Army. For the combat arms skills, the gain in expected service time in combat arms is .60-.80 years depending on location option.

o The cost per additional expected service year is lower for the \$1500 combat arms bonus than a similar cost for increases in RMC pay, recruiting and advertising. This is also true for the \$2500 non-combat arms bonuses. The cost per additional service year for the \$1000 increase in the combat arms bonus is much higher than the costs for RMC pay, recruiting and advertising increases. This study has also shown graphically the unattractiveness of attempting to increase accessions by raising RMC pay, which is necessarily applied over the entire military structure. The bonus, being a means of offering selective pay adjustments, is seen to be clearly preferable to such general pay increases.

o The cost per useful service year for four years with the \$1500 combat arms bonus is lower than the cost per useful service year for three years without the bonus only for MOS 13E, which has the highest variable training cost and longest training time of the combat arms skills.

o The cost per useful service year is lower for four year enlistments with the \$2500 non-combat arms bonus for several skills having high variable training costs and/or long training times (22L, 32E, 35J, 46N).

POLICY RECOMMENDATIONS

Evaluation of the cost-effectiveness of the enlistment bonuses depends on the assumed objectives of the bonus program.

o If the objective of the combat arms bonus is to increase accessions of mental group I-III high school graduates into the Army or into combat arms, then the analyses of this study have shown that a \$1500 enlistment bonus with the four year enlistment requirement is more economical than increases in recruiters, or advertising, or general pay increases. The study has also shown that the cost-effectiveness of the \$1000 increase in the combat arms enlistment bonus is very low - much less effective than increases in advertising and recruiting but still more effective than general pay increases. The \$1500 bonus should be retained in preference to these other means of increasing accessions, if that is the objective.

o If the objective of the combat arms enlistment bonus is solely to increase the committed term of service by one year, with no expected gain in total accessions, the bonus is not cost-effective, even at the \$1500 level, and should not be used for this purpose except for MOS 13E which has a high training cost and long training time.

o The non-combat arms bonus has been shown to have the capability of causing dramatic, cost effective improvements in accessions to certain hard-to-fill skills. The Army should retain the option of using these bonuses to increase accessions to high cost skills and to certain other hard-to-fill skills and should maintain sufficient flexibility to ensure that the list of skills for which bonuses are offered can be changed frequently as shortages are overcome in individual skills (which, as this analysis has shown, can occur very quickly when applied to an MOS whose total manning requirement is small). Overall accession management requirements will probably dictate, however, that the bonus program itself cannot reasonably be turned on and off at will.

o This study reinforces the Army's conclusion that enlistment bonuses should not be offered to GEDs if they are not also being offered to other non-high school graduates. Retention data show clearly that the expected service time for GEDs is no better than for the other non-high school graduates.

REQUIREMENTS FOR ADDITIONAL STUDY

Accessions to the Army

The analysis of the effects of the enlistment bonuses on accessions to the Army depends on a time-series analysis of accessions by date of accession and covers the time period January 1971-December 1974. During that interval the supply of high school diploma graduates was "small" relative to total accession requirements so that the expected accessions of that quality group in any one month was relatively unaffected by the Army's accession quotas for that month. By 1975, however, the supply of this quality group had grown significantly so that monthly accessions of this group were being controlled by the Army's overall quota for that month and the quotas in the first half of 1975 were not in keeping with previous seasonal quota assignments. As a result the 1975 data could not be included in the time-series analysis. This weakness could be substantially overcome by redefining the time series to classify enlistees by "contract date" which should be much less susceptible to distortion by monthly quota definitions.

Accessions to Combat Arms

The analysis of the effect of the combat arms bonus on accessions to combat arms can also be strengthened by reprocessing the accession data to create specific time series for combat arms accessions by education and mental group. This kind of detail in the combat arms area is not now available for such an analysis.

Accessions to Non-Combat Arms Skills

The analysis of accession gain in the non-combat arms skills covered the time period July-December 1974. In March 1975 a substantial reduction in this program was instituted. The analysis should be extended to include 1975 accessions to these skills to assess the reversibility of the process. That is, does eliminating the bonus reduce accessions in the same way offering the bonus increases accessions? This should also provide some additional insights into the expected results of reducing or eliminating the combat arms bonus. Of course, if the combat arms bonus is changed, analysis should be undertaken to assess the actual impact of the change.

Continuation Rates

This analysis should be extended at least to improve estimates of reenlistment rates and to continue monitoring changes in loss patterns during the first year of service.

1. THE EFFECT OF THE COMBAT ARMS ENLISTMENT BONUSES ON ARMY HIGH SCHOOL GRADUATE ACCESSIONS

OBJECTIVE

The purpose of this task was to determine the effect of the combat arms enlistment bonuses on accessions to the Army as a whole and accessions to combat arms. Specific attention is given to high school diploma graduates.

BACKGROUND

In June 1972, the Army started offering a \$1500 bonus for qualified enlistments into the combat arms specialties for terms of four or more years. In May 1973, the bonus was increased to \$2500 and was restricted to mental category I-III high school graduates (including GEDs). The combat arms enlistment bonus has continued without additional significant change to the present. Considering only diploma graduates, about 700 enlistees per month accepted the \$1500 bonus, while about 1000 per month accepted the \$2500 bonus. Table 1 shows the number of high school graduates who enlisted for the bonus by month from June 1972 to December 1974.

Prior Relevant Analyses

Several attempts have been made recently to assess the effect of the bonuses on accession in combat arms and accessions in the Army as a whole. In one analysis,¹ using a non-linear multiple regression on accession data in time-series form, it was estimated that the \$1500 bonus increased the supply of mental category I-III high school graduates to the Army by

¹Grissmer, D.W., et al, An Econometric Analysis of Volunteer Enlistments by Service and Cost Effectiveness Comparison of Service Incentive Programs, GRC Publication OAD-CR-66, October 1974, p. 159.

Table 1
COMBAT ARMS BONUS ENLISTEES, HIGH SCHOOL
DIPLOMA GRADUATES (TRUE VOLUNTEERS)

Month	Year	Number of enlistees	Month	Year	Number of enlistees
Jun	1972	1253	Jan	1974	953
Jul		1008	Feb		787
Aug		726	Mar		685
Sep		656	Apr		721
Oct		674	May		760
Nov		380	Jun		1986
Dec		473	Jul		1090
Jan	1973	708	Aug		1161
Feb		891	Sep		997
Mar		754	Oct		941
Apr		350	Nov		854
May		753	Dec		403
Jun		3087	Jan	1975	1452
Jul		1004	Feb		1537
Aug		1122	Mar		1566
Sep		1046	Apr		1894
Oct		808	May		2582
Nov		688	Jun		3593
Dec		620			

\$0-150 per month, an improvement of 0-4 percent relative to the FY1972 pre-bonus true volunteer accessions, and the \$2500 bonus increased the supply by 0-300 per month, or 0-8 percent.

A related analysis,² using the results of AFEES surveys, estimated that about 14 percent of those who accepted the \$1500 bonus (including mental category IV high school diploma graduates and non-high school graduates) claimed that they would not have entered the Army at all. Among those who accepted the \$2500 bonus between July and October 1973, 17 percent claimed they would not have joined the Army without the bonus and an additional 30 percent claimed they would have joined the Army but would not have enlisted in combat arms.

A third analysis,³ using basically the same time-series, multiple regression techniques as reference 1 but over a longer time period, estimated that neither bonus level attracted any new high school diploma graduate enlistees to the Army - that virtually all bonus recipients would have enlisted without the bonus, most for three years.

There are some obvious inconsistencies in these results. Reference 2 says that 17% of the bonus recipients would not have joined the Army without the bonus, while reference 3 says that the bonus did not increase the supply of enlistees. Reference 1 does not disagree with the others but has such wide limits on its results that it provides no additional clarification either.

METHODOLOGY

This present study has attempted to resolve the ambiguities pointed out above by the application of an improved methodology for multiple regression. Fundamental difficulties arise in conventional multiple regression when the correlation matrix is ill-conditioned (badly non-orthogonal) as are the time-series regressions used in the OSD accession forecasting models. In general, the solution vector is unstable and "too long." By "too long" we mean that many of the coefficients are too large

²Ibid., pp. 162-166.

³Grissmer, D.W., et al, An Evaluation of the Army Two Year Travel and Training Options, GRC Publication OAD-CR-113, June 1975, p. 34.

and frequently of the wrong sign (unless sign restrictions are introduced as has routinely been done in the specification of the OSD accession forecasting models). One method of coping with such ill-conditioned problems is called Ridge Regression. While not a new development, Ridge Regression has only recently received serious attention and currently is going through an extensive evaluation and expansion in the professional community. A good exposition of the problem is given as Appendix A to this paper.

The GRC nonlinear time series multiple regression program was modified to use the Ridge methodology and was used to attempt to reduce the uncertainties about the effects of the combat arms enlistment bonus reflected in the earlier analyses.

Total Army Accessions

A series of Ridge Regressions were first run for the following Total Army accession groups:

1. A123HS - Mental Category I-III, High School Diploma Graduates
2. A4HS - Mental Category IV, High School Diploma Graduates
3. AHS2YR - High School Diploma Graduates, Two Year Enlistees
4. AHS3YR - High School Diploma Graduates, Three Year Enlistees
5. AHS4YR - High School Diploma Graduates, Four Year Enlistees

The independent variables used are defined in Table 2. In general, all the independent variables were used for a given accession group and reruns made, eliminating those independent variables whose F values and coefficients were very small. The time period for the runs was January 1971 to December 1974. It was not practicable to include 1975 data since, by that time, the robust condition of the DEP allowed the Army to enter numbers of men in some months that were seriously in conflict with historical accession patterns. This problem could be resolved by replacing accessions by contracts since contracts are less susceptible to very short term variations in accession requirements.

The results of the Ridge Regressions for accession groups one through five are shown in Appendix B. The results for AHS3YR are shown here in Fig. 1 for illustration. These figures are related to the "Ridge Trace" discussed in Appendix A. The left vertical scale in these figures represents the proportion of the model's January 1975 forecast deseasonalized accessions

Table 2
REGRESSOR VARIABLES

1. General Variables

a. MILCIVPAY - This time series is the ratio derived by GRC of military RMC for grade E-1 to the civilian average weekly wages for two industries — Wholesale and Retail Trade and Services. Source of RMC data is DCSPER, DAPE-MPE. The data on civilian average weekly earnings are the average for the two industries from the Department of Labor, BLS, monthly publication, "Employment and Earnings," Table C-2.

b. DUNEMPL1 - This variable is the deseasonalized unemployment rate for the 16-21 year old, male, out-of-school labor force. It was created at GRC by applying the deseasonalization factors derived from regressions on trend from January 1970 to September 1973.

c. RECR - This is the number of recruiters on production each month.

d. UOCCAN - This is the number of Unit of Choice Canvassers on production for the Army.

2. Enlistment Option Variables

a. CAOPTS - Number of combat arms enlistment options - Army.

b. TWOYROPT - Dummy variable for the Army two year travel/training enlistment option.

3. Enlistment Bonus Dummy Variables

a. BNS-HS - Army and Marine \$1500 combat arms bonus for high school graduates.

b. BNS-INC - Army and Marine \$1000 increment in combat arms bonus (i.e., the difference between the \$1500 and \$2500 bonus).

c. BNSKLA - Army Skills Bonus - May, June 1973.

d. BNSKLM - Army and Marine Skills Bonus - June 1974 to present.

4. Miscellaneous Variables

a. ACAT4LIM - Army limit in percent on total Cat IV enlistments.

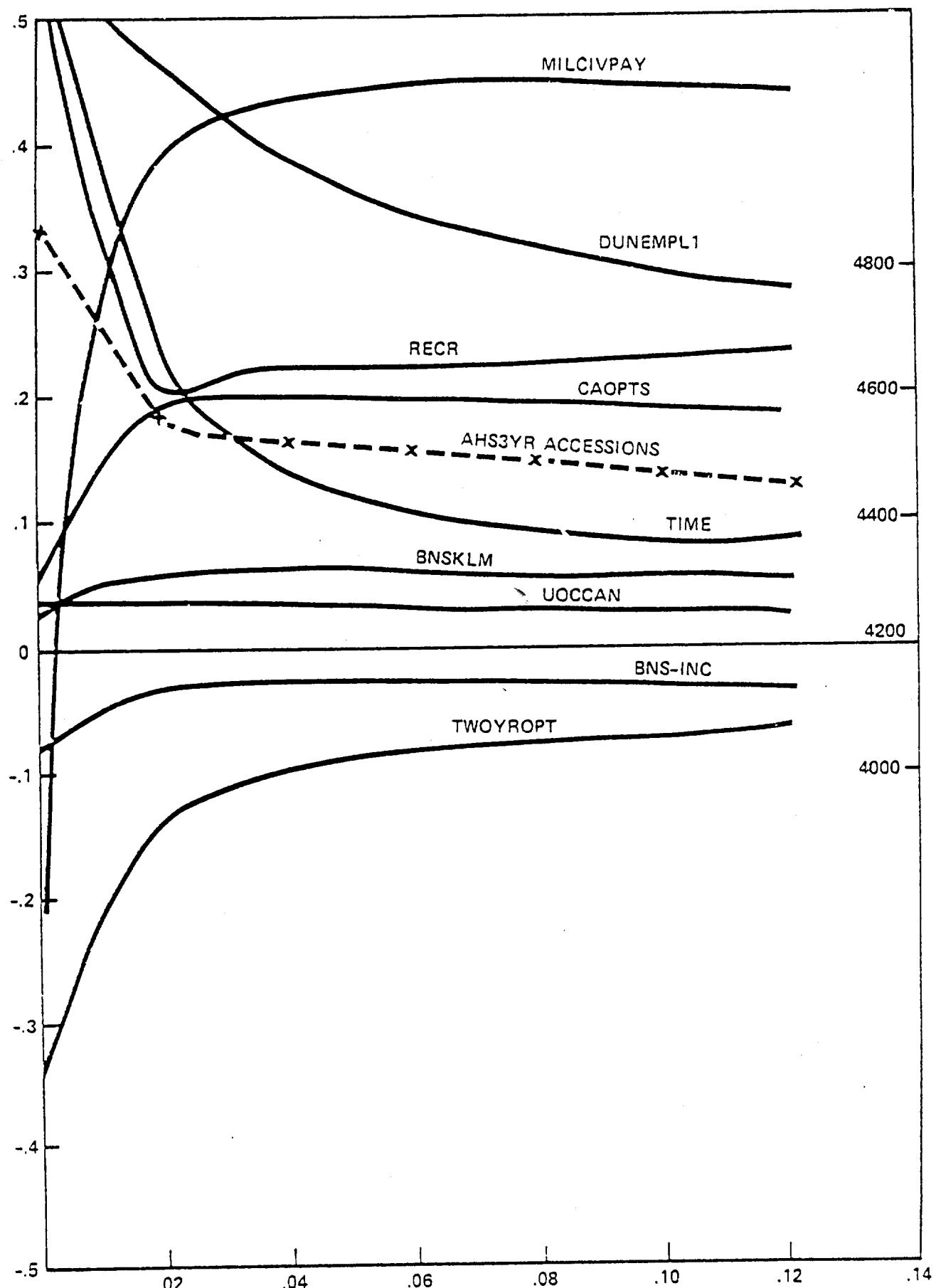


Fig. 1—Ridge Trace, AHS3YR

accounted for by the particular variable. The right vertical scale is the predicted January 1975 forecast deseasonalized accessions represented by the dashed line on the graph.

As can be seen, good stability in the coefficients is achieved in all cases for k's of less than .2. The one frequent exception is the deseasonalized youth unemployment variable, DUNEMPL1, which persistently declines; with increasing k the difference is usually picked up by the constant.

The ranges of contributions to the January 1975 forecast for the most important independent variables are shown in Table 3. Note that as yet there does not exist a uniquely defined "best" Ridge solution so that a range of solutions using small values of k, and showing reasonable stability over the selected range of k must be considered. It is clear that the consistency of effect among accessions groups for these independent variables is quite good. The differences in the January 1975 accessions forecast between the sum of A123HS and A4HS and the sum of AHS2YR, AHS3YR and AHS4YR is comparable with the differences in the available historical data for these groups arising from incomplete and/or late entries in the USAREC accession records for that period. It may also be noted that the range of likely values of the coefficients of all of the independent variables is much smaller than has been achievable by earlier methods.

Combat Arms Accessions

In an attempt to assess the effect of the bonuses on combat arms accessions, a separate Ridge Regression on high school diploma graduate combat arms enlistees (CAHSD) was performed. The coefficients of the variables representing both \$1,500 bonus and \$1,000 increment went quickly to zero with very small F values - neither had any appreciable effect on the number of high school diploma graduates entering combat arms specialities. A review of the deseasonalized time series for CAHSD, as in Table 4, reinforces this conclusion.

CONCLUSIONS

Accession Gains to the Army Due to the Combat Arms Enlistment Bonuses

Of particular interest to this study are the three variables BNS-HS, BNS-INC and BNSKLM representing the offering of the \$1,500 combat arms bonus, the \$1000 increment in the combat arms bonus and the non-combat arms bonus offered between June and December 1974. The range of values

Table 3
COMPARISON OF RIDGE REGRESSION RESULTS

Accession group	Range of k	Desesasonalized January 1975 forecast		Independent variable contributions to desesasonalized January 1975 forecast ^a					
		BNS-1S	BNS-INC	BNSKLM	TWYROPT	WILCIVPAY	RECR	UOCGAN	DUMEPPL
(1) A12HS	.12-.20	6140-6050	270-215	0	455-425	290-305	220-270	600-575	240-230
(2) A4HS	.04-.10	1135-1150	0	0	0	0	620-530	305-330	0
(3) A152YR	.08-.12	1390-1300	(-65)-(-45)	0	(-50)-0	420-425	(-120)-(-105)	105-110	200-185
(4) A153YR	.08-.14	4490-4430	0	(-145)-(-150)	245-215	(-350)-(-270)	650-620	550-570	100-85
(5) ASH4YR	.10-.18	1290-1275	425-375	85-110	175-150	0	0	130-170	0
(1)+(2)		7275-7200	270-215	0	455-425	290-305	840-800	905-905	240-230
(3)+(4)+(5)		7170-7005	360-330	(-60)-(-40)	370-365	70-145	530-515	785-850	300-270
									495-395

^aSee Table 2 for definitions of independent variables.

Table 4

MANPOWER PREDICTION MODEL

		CAHSO		1.0		ACOMB-ARM		1.0		ACA-NB-NH		1.0		ANHSLYR	
SEASONAL FACTORS		JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.		
MON. YR.	ACTUAL	FORECAST	RESIDUAL	PCY.	ERR.	DESEAS ADJ									
JAN. 71	254.870	242.168	12.702	4.98	270.996										
FEB. 71	191.390	251.652	-60.262	-31.49	219.257										
MAR. 71	207.970	263.852	-55.882	-26.87	269.607										
APR. 71	203.	333.253	-395.617	-41.917	-30.8	-55.101									
MAY 71	511.933	406.411	29.497	5.76	635.562										
JUN. 71	214.2.910	1962.310	-186.906	6.44	996.964										
JUL. 71	165.0.620	1425.121	243.499	14.74	1188.651										
AUG. 71	151.0.733	1444.133	66.163	6.39	1156.137										
SEP. 71	154.0.560	1436.401	102.155	6.63	1251.967										
OCT. 71	-921.539	1066.913	-143.383	-15.56	-1046.310										
NOV. 71	923.513	946.114	-55.604	-5.39	1492.453										
DEC. 71	1356.503	1273.576	92.924	6.80	-1987.312										
JAN. 72	161.0.753	1602.097	2.551	1.17	1706.265										
FEB. 72	1227.046	1170.370	-153.340	-212.50	-1405.703										
MAR. 72	1510.563	1044.232	-83.672	-8.24	1408.221										
APR. 72	948.933	626.956	-139.992	-14.16	1816.632										
MAY 72	1113.403	957.236	56.162	5.54	1047.612										
JUN. 72	315.623	315.620	-19.000	-6.04	1463.557										
JUL. 72	2511.916	1933.333	26.637	1.42	1440.143										
AUG. 72	1672.290	1686.660	-111.370	-6.68	1298.731										
SEP. 72	1619.900	1627.583	-7.683	-4.47	1316.150										
OCT. 72	1293.120	1395.095	104.225	8.61	1475.070										
NOV. 72	799.610	850.221	-50.611	-6.33	1199.491										
DEC. 72	616.360	649.679	-33.119	-4.04	1187.672										
JAN. 73	1167.340	1163.041	-95.701	-8.97	1146.872										
FEB. 73	1297.220	1131.279	-165.941	-12.79	1408.162										
MAR. 73	1037.750	851.559	196.151	11.53	116.305										
APR. 73	523.653	674.356	-146.106	-27.61	-168.223										
MAY 73	853.446	894.205	-51.825	-5.96	1387.547										
JUN. 73	3415.533	3105.432	-236.338	-6.70	-1598.341										
JUL. 73	1500.030	1660.193	-126.193	-6.22	1116.628										
AUG. 73	1576.300	1551.678	-24.322	-1.54	1246.544										
SEP. 73	1553.300	1551.724	-23.724	-1.15	1249.545										
OCT. 73	1150.030	1105.714	-54.284	-3.01	1298.399										
NOV. 73	570.000	468.091	-101.909	10.51	1455.092										
DEC. 73	224.030	893.493	-66.493	-8.67	1198.350										
JAN. 74	1395.000	1262.241	-212.759	6.38	1483.264										
FEB. 74	1151.600	1121.268	-29.712	-2.58	1310.591										
MAR. 74	932.000	1247.801	-153.861	-11.93	804.545										
APR. 74	1166.000	1154.613	-12.666	-1.29	1360.421										
MAY 74	719.000	736.785	-17.785	-2.47	1318.351										
JUN. 74	1111.300	1126.338	-17.338	-1.56	902.675										
JUL. 74	609.000	649.647	-1.953	-2.2	1116.697										
SEP. 74	777.000	742.794	-34.206	1.08	986.695										
OCT. 74	405.000	425.420	-20.428	-5.04	1165.574										
DEC. 74					586.995										

for these variables as shown in Table 3 is quite narrow and reasonably consistent over the accession groups. (The positive coefficient of BNSKLM for AHS3YR is somewhat troublesome and implies that the non-combat arms skills bonus was not the only thing increasing accessions during that time period. The negative coefficient for MILCIVPAY for AHS2YR suggests that raising pay tended to reduce resistance to the longer term of enlistment. It is seen that the \$1500 combat arms bonus is associated with a 380-425 per month increase in AHS4YR and a 215-270 increase in mental group I-III high school graduate accessions to the Army. On the other hand, the \$1000 increment in the combat arms bonus increased accessions in AHS4YR by 90-110 per month with a slightly more than compensating decrease in AHS3YR. The net effect on accessions to the Army is zero for the \$1000 bonus increase.

Accession Gains to Combat Arms Due to the Combat Arms Enlistment Bonuses

Combining the results for CAHSD with the results for the other accession groups, one infers that while the \$1500 bonus brought 250 additional enlistees per month into combat arms, they replaced an equal number of (presumably) lower quality enlistees who would have been willing to enlist in combat arms but who instead were required to choose other skills. Data are not available on accessions in combat arms by mental group in FY72 so that this replacement phenomenon cannot be proven statistically at this time. However, it has been rather generally accepted that, in the pre-bonus period, the mental group IV content as well as the non-high school graduate content of combat arms was substantially less favorable than the non-combat arms accessions. Table 5 shows that the differences between combat arms and non-combat arms quality levels are much smaller since the introduction of the bonus.

Table 5
QUALITY DISTRIBUTION OF COMBAT ARMS
AND ALL NPS MALE ENLISTEES

	FY73		FY75	
	Combat Arms	All NPS Male	Combat Arms	All NPS Male
Mental Group I-III	84%	83%	91%	89%
Mental Group IV	16%	17%	7%	11%
High School Diploma	44%	52%	51%	54%
GED's	5%	6%	13%	8%
Blacks	19%	21%	19%	23%

In sum, the \$1500 bonus could have increased high school diploma graduate enlistees by 17 percent (relative to pre-bonus accession levels) with a modest improvement in average quality, but rather the bonus brought in higher quality enlistees who were used to replace other potential combat arms enlistees for a more dramatic improvement in average quality. The switching effects associated with the introduction of the \$1500 bonus are summarized in Fig. 2. The \$1000 increment, of course, simply caused about 100 combat arms enlistees per month to choose a longer term of service.

Contributions of the Bonus to Current Accession Levels

As shown above, the introduction of the \$1500 combat arms enlistment bonus increased the supply of mental category I-III high school diploma graduates by 6-7 percent. The overall accessions in this category in FY76 are substantially higher than during the FY72 pre-bonus period for several reasons, including increases in the recruiting effort and a higher unemployment rate. Relative to this higher accession level the \$1500 bonus is seen to yield about a 3 1/2 percent improvement in accessions of mental category I-III high school diploma graduates to the Army.

Since the \$1000 increase in the bonus did not increase accessions to the Army relative to accessions prior to the increase, it is inferred that it also has no impact on total accessions at the FY76 level of accessions.

OTHER SIGNIFICANT RESULTS

Much of the results of these Ridge Regressions are of more general interest than the primary objective of this study. Of particular interest are estimates of the elasticities of the accession variables related to some of the principal independent variables. Estimates of these elasticities, provided by the Ridge Regressions, are given in Table 6.

NO BONUS (all 3 year HSG enlistees)

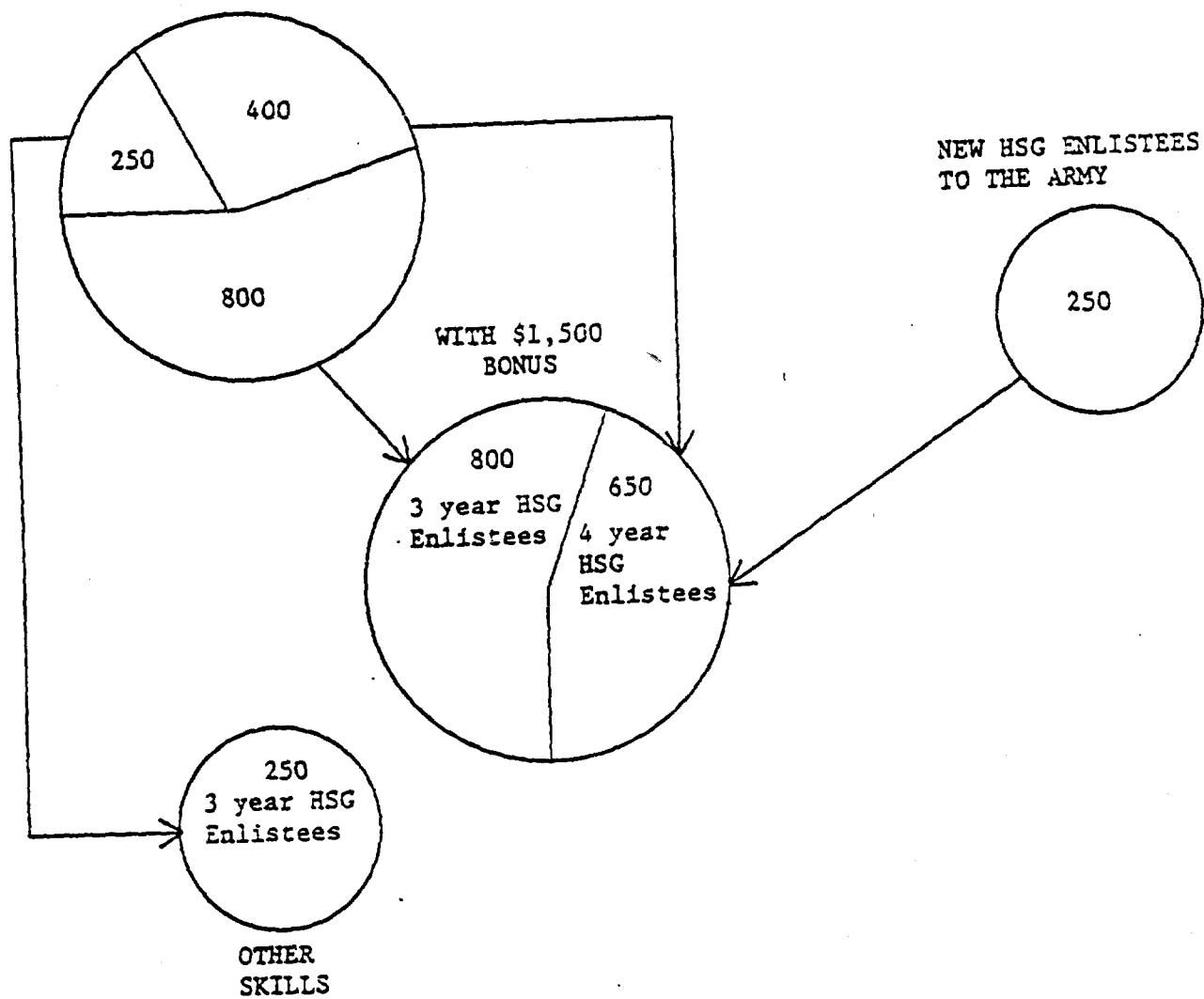


Fig. 2—Sources and Dispositions of Combat Arms High School Graduate Enlistees When the \$1500 Enlistment Bonus Was Offered

Table 6
MEAN ELASTICITIES OF THE ACCESSIONS GROUPS
RELATIVE TO CERTAIN INDEPENDENT VARIABLES

Accession Group	INDEPENDENT VARIABLES			
	RECR	UOCCAN	MILCIVPAY	DUNEMPL1
A123HS	.18	.05	.14	.12
A4HS	.47	-	1.51	.73
AHS2YR	.13	.17	-.24	.21
AHS3YR	.21	.03	.46	.31
AHS4YR	.29	-	-	-
CAHSD	.38	-	.35	.59

NOTE: A dash indicates that the independent variable was found to have no significant effect on the accession group.

2. THE EFFECT OF THE NON-COMBAT ARMS ENLISTMENT BONUS ON ARMY ACCESSIONS

OBJECTIVE

This task attempts to determine how the non-combat arms enlistment bonus effects accessions to the Army and high school graduate accessions to the skills for which the bonus is offered.

BACKGROUND

Since June 1974, the Army has offered enlistment bonuses to high school graduates in several hard to fill non-combat arms MOSs for four-year enlistments. The Army had, since June 1972, been offering enlistment bonuses to high school graduates for four year enlistments in combat arms skills and had achieved a 17 percent increase in the supply of high school diploma graduate volunteers in combat arms (Chapter 1). This study assesses the effect of the non-combat arms bonuses on accessions in the affected MOSs and attempts to define general conclusions concerning the expected effects of such bonuses on various classes of skills.

METHODOLOGY

Enlistment records for two time periods -- January through May 1974 and July through December 1974 -- were separately processed and all accessions in the bonus skills were classified by MOS, sex, race, education, mental group and term of enlistment. The bonus skills and bonus award levels applicable to the July-December 1974 period are shown in Table 7. Each of the cell totals was then converted to an annual equivalent by applying seasonal factors and adjusting for differences in the two time periods in pay, unemployment and number of recruiters on production. The adjustments were made separately for high school graduates and

Table 7

NON-COMBAT ARMS MOSs WITH BONUS OFFERED - JUNE-DECEMBER 1974

MOS	Description	Bonus
05C	Radio Operator	\$1500
12B	Combat Engineer	2500
15D	Lance Crewman	1500
15E	Pershing Crewman	2500
15J	Lance/HJ CP/ED Assistant	1500
16D	Hawk Crewman	1500
16P	Chaparral Crewman	2500
16R	Vulcan Crewman	2500
17K	GSR Crewman	1500
21G	Ballistic Missile Maintenance	1500
22L	NIKE Test Equipment Repairman	2500
27D	Lance Repairman	2500
27E	Wire Guided Missile Repairman	1500
27H	Shillelagh Repairman	2500
31M	Multichannel Communications Repairman	1500
31S	Field Generate COMSEC Repairman	1500
31T	Field System COMSEC Repairman	1500
32E	Fixed Station Equipment Repairman	2500
35J	Aircraft Fire Control Repairman	2500
36H	Dial Central Repairman	1500
45P	Tank Turret Mechanic	1500
45R	Missile Tank Turret Mechanic	1500
46N	Pershing Mechanical Electrical Repairman	2500
52B	Power Generator Equipment Operator/Mechanic	1500
55B	Ammunition Storage Specialist	1500

Table 8
PERCENT IMPROVEMENT IN HIGH SCHOOL GRADUATE ACCESSIONS

MOS group	\$1500 skills	\$2500 skills
Artillery crewman	1.0	194.5
Artillery and missile maintenance	6.2	104.8
Other maintenance	.1	310.4
All skills not artillery or missile related	17.6	95.9
All maintenance skills	.4	169.0
All bonus skills	14.3	115.3

Table 9
FIRST TERM MANNING LEVELS
June 30, 1975

\$1500 Skills		\$2500 Skills	
MOS	First Term Manning %	MOS	First Term Manning %
05C	64.1	12B	106.4
15D	67.7	15E	89.6
15J	118.0	16P	84.9
16D	89.6	16R	122.7
17K	209.4	22L	26.8
21G	*	27D	288.0
27E	99.2	27H	139.6
31M	84.2	32E	58.4
31S	210.8	35J	39.1
31T	166.2	46N	61.7
36H	92.1		
45P	115.5		
45R	54.8		
52B	85.1		
55B	70.1		

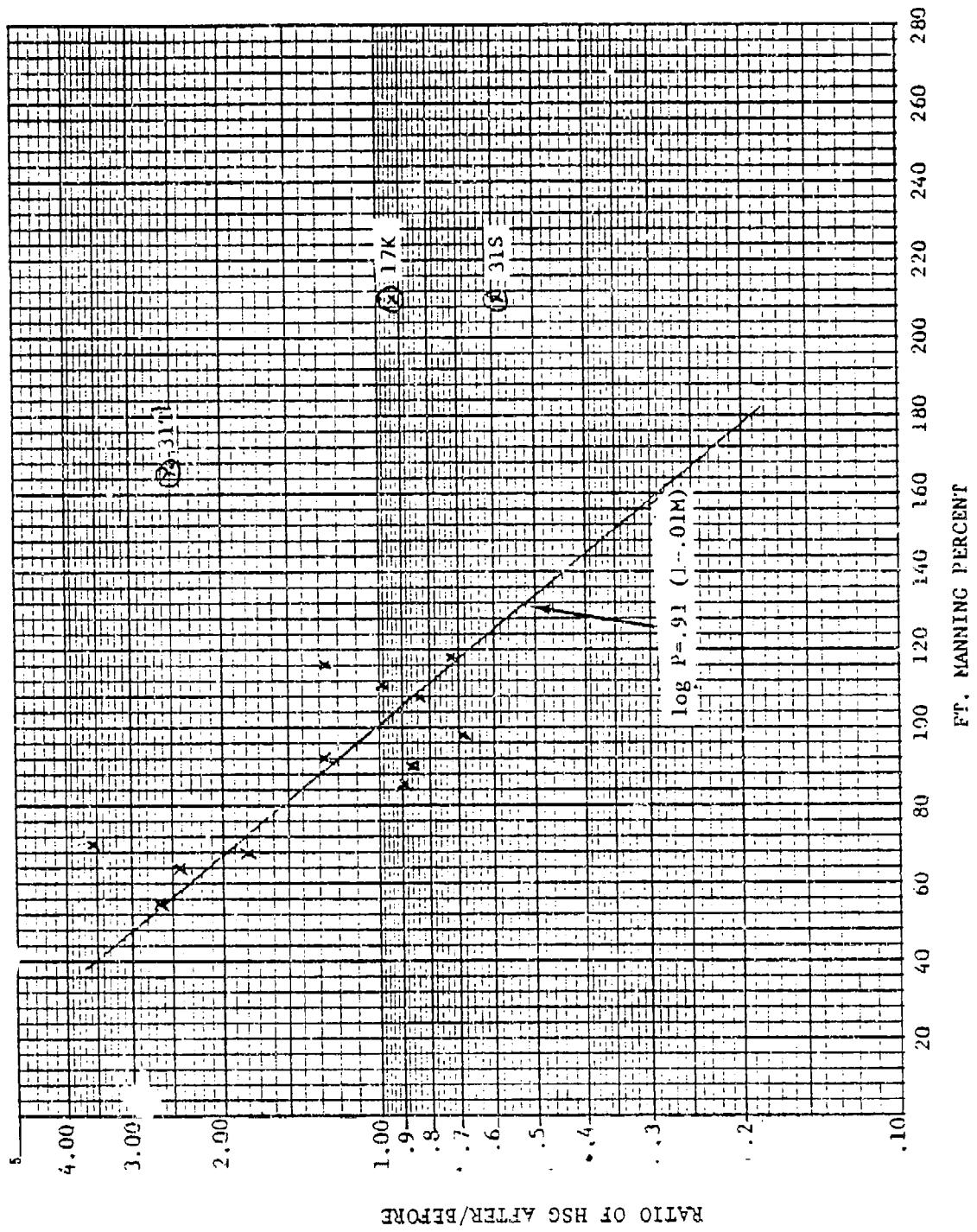


Fig. 3—High School Graduate Improvement vs. First Term Manning
§1500 Skills

non-graduates. The results of these computations are given in Appendix C for each MOS and for various logical combinations of MOSs. Appendix C also gives, for each MOS or combination of MOSs, the percent gain in accessions and enlisted man years for total accessions and NPS male, mental category I-III A, high school graduate and black accessions.

GENERAL RESULTS

The effect of the bonus on accessions is highly variable. It is clear, however, that the \$1,500 bonus attracts very few enlistees when a larger bonus is offered in a closely related skill. Overall, the increase in total accessions in the \$2,500 skills was 26 percent, while accessions in the \$1,500 skills decreased by 10 percent. In terms of high school graduates only, accessions in the \$2,500 skills increased by 115 percent while accessions in the \$1,500 skills increased by only 14 percent.

The improvement in high school graduate accessions for various combinations of skills is summarized in Table 8.

Several attempts were made to correlate the improvement in high school graduate accessions for particular MOSs to other factors, including first term manning as a percent of requirements (see Table 9) and the annualized number of high school graduates in the January to May 1974 pre-bonus period. Fig. 3 plots the ratio of high school graduate accessions with the bonus to high school graduate accessions in the pre-bonus period (R) to the June 1974 first term manning percent (M). With three obvious exceptions (17K, 31S, 31T), the points appear decidedly non-random. A simple least-squares fit of $\log R$ versus M for the 12 conforming points yields a predictor:

$$\log R = .91 (1-.01M) \quad (1)$$

The straight line plotted on Fig. 3 represents this predictor. Note that at 100% manning R equals 1 and that the slope of the line is in the logical direction. It may also be observed that if a line were plotted among the three non-conforming points, its slope would be approximately the same.

An attempt to establish a similar relationship between first term manning and high school graduate accessions improvement for the \$2500

skills failed - there did not appear to be any correlation for the \$2500 bonus skills or for any logically definable subset of them.

Plotting the percent improvement in high school graduates (?) against pre-bonus high school graduate accessions (A) on a log-log scale for the \$2500 bonus skills, however, shows a good fit for most of the skills (see Fig. 4). Two skills (22L and 46N) differ widely from the others and a third, 35J, could not be plotted since it had zero pre-bonus accessions and hence an infinite improvement factor. The least squares-fit for this plot is very close to

$$P = 2400/\sqrt{A} \quad (2)$$

In other words, the percent improvement in high school graduate accessions for these \$2500 bonus skills was inversely proportional to the square root of the pre-bonus high school graduate accessions.

A similar relationship could not be established for the \$1500 bonus skills.

Black Participation

Generally speaking, the black percentage of accessions increased faster than total accessions in the bonus skills. The overall increase of 10 percent in black accessions in these skills appears to be in line with the overall trend of increasing black accessions for the Army over this time period. The increase in black accessions for various combinations of skills is compared with the total accessions in Table 10. From Table 10 it can be seen that the increase in black accessions is uniformly greater than the total increase for the \$1500 skills while, on balance, there is little difference at the \$2500 level.

Total Bonus Accessions

The annualized increase in male high school graduates in these skills combined is 3150, or about 260 per month. The increase in four year high school graduate enlistees is 4040 per year, or about 335 per month. Comparing these results with Table 3 it can be concluded that the offering of the non-combat arms skills bonus draws about 100 four year enlistees per month away from combat arms skills and that the increase of 475 in mental category I-III high school graduate accessions attributed to the non-combat arms skills bonus clearly is an overstatement of the bonus' effect — as was suggested in Chapter 1 by the fact

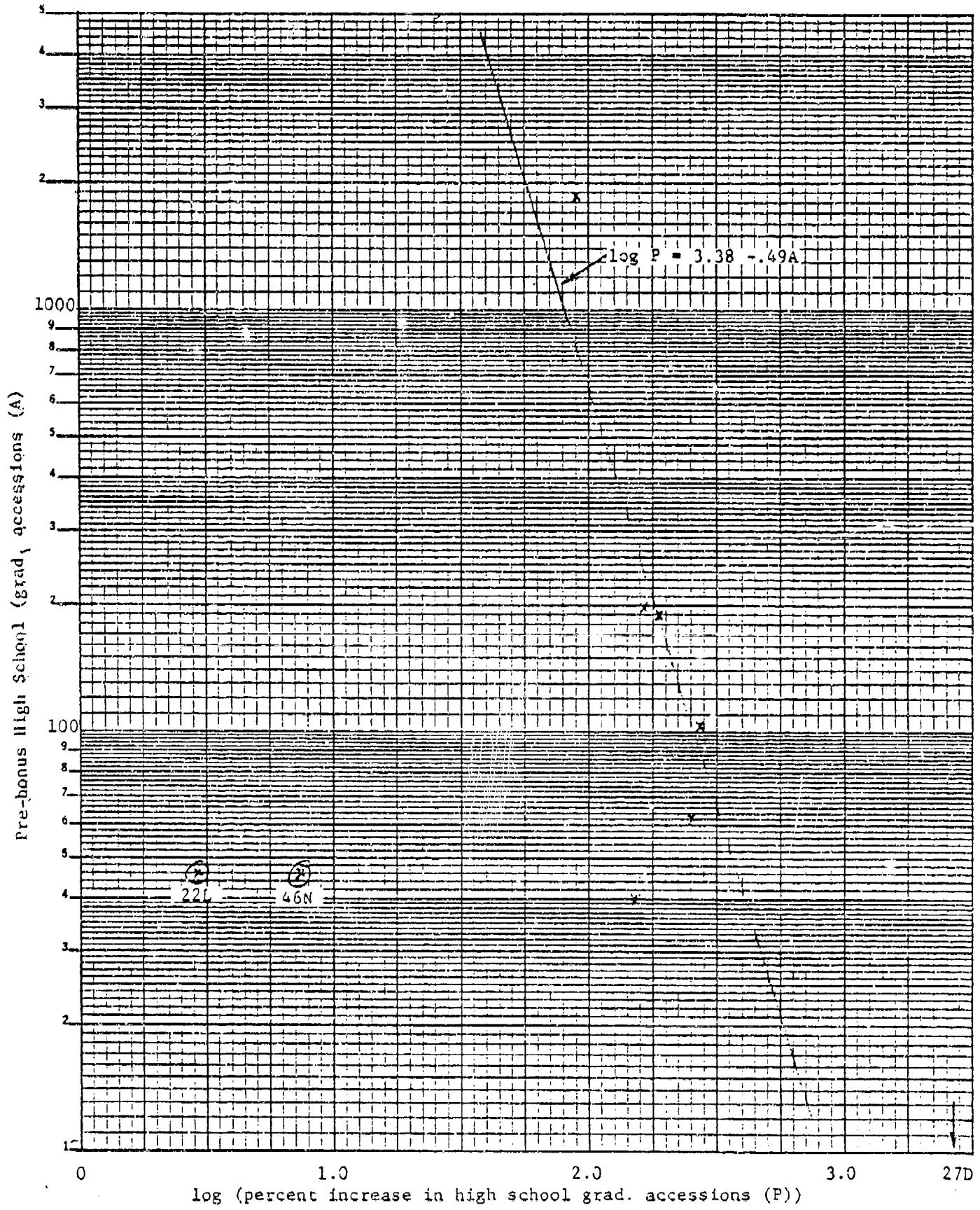


Fig. 4—High School Graduate Improvement Factors Vs. Pre-bonus Accessions
\$2500 Skills

Table 10
PERCENT IMPROVEMENT IN HIGH SCHOOL GRADUATE ACCESSIONS
BLACK ACCESSIONS VERSUS TOTAL ACCESSIONS

MOS Group	\$1500 Skills		\$2500 Skills	
	Black Acc.	Total Acc.	Black Acc.	Total Acc.
Artillery Crewman	23.2	1.0	130.0	194.5
Artillery and Missile Maintenance	14.0	6.2	227.8	104.8
Other Maintenance	4.1	.1	400.0	310.4
All Skills not Artillery or Missile Related	24.3	17.6	97.3	95.9
All Maintenance Skills	4.7	.4	275.0	169.0
All Bonus Skills	18.2	14.3	113.8	115.3

that the coefficient for the non-combat arms skills bonus was positive for three-year high school graduate enlistees.

CONCLUSIONS

So long as the total number of pre-bonus high school graduate accessions is not too small in the skills considered, offering enlistment bonuses in non-combat arms skills can yield an increase of 250-300 high school graduate accessions to these skills.

Bonuses smaller than the maximum offered will attract few enlistees and the overall increase in high school graduate accessions in the small bonus skills will be very small. With certain extraordinary exceptions the gain (loss) in high school graduate accessions in these skills will be distributed approximately in proportion to the first term manning level.

Bonus skills offering the maximum bonus can yield an improvement in high school graduate accessions of over 100%, as a group. The individual skill improvement factors should be inversely proportional to the square root of the pre-bonus high school graduate accessions. Most of this improvement will be at the expense of other skills in the Army, including skills offering a smaller bonus.

Black participation in these skills was not changed by the bonuses out of proportion to the change in total black accessions in the time period used in the analysis.

3. LOSS RATE AND CONTINUATION RATE ANALYSIS FOR FIRST TERM ENLISTEES

OBJECTIVE

The purpose of this task is to determine loss and continuation rates as a function of time in service for various categories of Army first term enlistees, and to estimate the Expected Service Time for these various categories.

METHODOLOGY

In the preceding chapters estimates were made of the effects of the enlistment bonuses on the supply of enlistees to the Army and to the particular skills for which bonuses were offered. To accomplish a more precise measurement of the gains attributable to the bonus, it is necessary to determine the rate at which such enlistees leave the service. (The rate at which these enlistees leave the skill while remaining in the service will be discussed in the next chapter.)

While it would be possible to use various accession and gain/loss transaction files to estimate loss rates at certain fixed lengths of service, it was apparent that the data were available to accomplish a more comprehensive evaluation of first terms loss patterns. The data to be used was a computerized file containing one record for each Army volunteer enlistee with accession date between January 1971 and March 1975 (about 700,000 records). Each record contained data on race, education, enlistment option, term of enlistment and mental group. In addition, the record contained date and type information for every gain and loss transaction that occurred from (and including) the initial accession date through March 1975. With this data it was possible to estimate loss rates by month of service for a wide range of categorizations up to a

theoretical maximum of 50 months of service. In many categorizations, of course, the maximum exposure would be less than 50 months if the particular category had no enlistees during some early months of the January 1971-March 1975 period.

Given the loss rate for a particular month of service it is then possible to construct a Continuation Function as in equation 3.

$$C_i = C_{i-1}(1-\ell_i) \quad (3)$$

where C_i is the probability of continuing in the Army through the i^{th} month and ℓ_i is the estimated loss rate in the i^{th} month (i.e., the probability that an enlistee who is present at the end of the $(i-1)^{\text{th}}$ month lost during the i^{th} month. The Continuation Rate is obviously a non-increasing function of month of service and will appear generally as in Fig. 5.

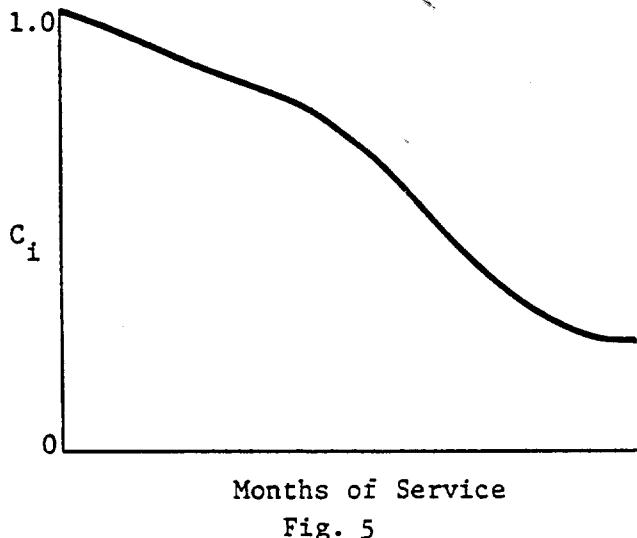


Fig. 5

With these Continuation Rates (which are analogous to actuarial life tables or reliability survival functions) loss rates for any months of service interval can be read directly.

In addition to the loss rate calculation, this analysis also calculates the monthly reenlistment rates by dividing reenlistments in the i^{th} month by the population in the i^{th} month of service. An estimate of the fraction of original entrants who reenlist can then be obtained as:

$$R = \sum_i r_i C_i \quad (4)$$

where r_i is the reenlistment rate and C_i the continuation rate for the i^{th} month. Reenlistees are not counted as losses in this analysis.

The breadth of data available in the file permitted a wide range of cross-categorizations to be considered. A set of 945 classifications was actually analyzed. This set consisted of all cross-categorizations of the following:

- o Race
 - White and other
 - Black
 - All
- o Accession Date
 - January 1971 through June 1973 ("Era 1")
 - July 1973 through March 1975 ("Era 2")
 - January 1971 through March 1975
- o Education/Mental Group
 - High school diploma graduate/mental group I-IIIA
 - High school diploma graduate/mental group IIIB
 - High school diploma graduate/mental group IV
 - High school diploma graduate/all mental groups
 - General education development (GEDs)
 - Other non-high school graduates
 - High school diploma graduate plus GEDs
- o Term of Enlistment/Enlistment Option
 - Two year/RA(U)
 - Two year/Travel option
 - Two year/training option
 - Two year/all enlistees
 - Three year/RA(U)
 - Three year/combat arms-EUROPE
 - Three year/combat arms-CONUS
 - Three year/combat - all options
 - Three year/non-combat arms
 - Three year/all enlistees

- Four year/combat arms-Europe
- Four year/combat arms-CONUS
- Four year/combat arms - all options
- Four year/non-combat arms
- Four year/all enlistees

Prior to these categorizations, certain enlistees were screened from the file. In particular, Era 1 enlistees who were 18 or older at enlistment and had lottery numbers less than 150 were removed.

RESULTS OF THE ANALYSIS

General Results

The detailed results of these analyses are given in Appendix D. In Appendix E, some important relationships among continuation functions are presented graphically.

The unfavorable experience of non-high school graduates is clearly shown in these results. Somewhat surprisingly, the experience of GEDs is seen to be as unfavorable as the other non-high school graduates.

Appendix E also shows that the loss rates for recent enlistees are somewhat higher in the very early months of service than is true for Era 1 enlistees, but that after 12 months there appears to be little overall difference in net losses. The results also show that blacks with four year combat arms enlistments have higher retention than whites, but that the reverse is true for three year enlistees; that combat arms enlistees with Europe options continue to have a more unfavorable loss experience than other combat arms enlistees, and that non-combat arms enlistees with four year enlistment terms have somewhat higher retention rates than do the four year combat arms enlistees. The results also show that there is relatively little difference, at least in the first year of service, in the continuation rates for three and four year enlistees of similar types.

First Year Loss Rates

Generally speaking, loss rates are highest in the first year of service and (ETS-like losses aside) tend to decline rather steadily over time, reaching a near-steady state after about 25-30 months. The continuation rates through four months are of special interest for combat arms bonus enlistees, since at that time they will be completing

Individual Training and will become eligible to receive the bonus. Tables 12, 13 and 14 show four and twelve month loss rates for various classes of enlistees. Tables 13 and 14, in particular, show that high school graduates mental group I-IIIAs four year combat arms enlistees showed a four month loss rate in Era 1 of 7% while for Era 2 enlistees this loss rate is 8%.

Expected Service Lives

A natural extension of the development of the continuation rates will provide direct estimates of the expected time of service for particular categories of enlistees.

For this study the Expected Service Life, U , is defined as

$$U_{48} = \sum_{i=1}^{48} C_i / 12 \quad (5)$$

and represents the expected number of years of service out of a possible four years maximum.

One problem that arises in this analysis is that the continuation rates are not always available over a full 48 month period. In these cases, estimates of monthly loss rates for the period beyond the available data are required. Based on the loss data produced with the results in Appendix C, generalized average monthly loss rates are estimated and given in Table 15.

Using the data in Appendix D and Table 15, the Expected Service Life defined in equation (5) can be obtained by successive applications of equations (6) and (7).

$$U_b = U_a + C_a \left[\left(\frac{1-\lambda}{\lambda} \right) \left(i - (1-\lambda)^{b-a} \right) \right] \quad (6)$$

and

$$C_b = (1-\lambda)^{b-a} C_a$$

where λ is the generalized monthly loss rate.

Table 16 shows the Expected Service Times for the various combinations of Era, Race, Term of Enlistment and Education/Mental Group. The relationships shown here support the conclusions drawn in Table 12. In

Table 12
 LOSS RATES AT FOUR AND TWELVE MONTHS
 ALL ENLISTMENT OPTIONS BY EDUCATION/MENTAL GROUP

Acc Group	Term	Race	HS			HS			NHS		
			I-IIIA	IV	4 mo/12 mo						
71/01- 73/06	3 yr	White	.06/.13	.10/.18			.07/.13		.14/.29		.11/.27
		Black	.05/.14	.05/.13			.05/.12		.10/.25		.07/.23
		All	.06/.14	.07/.14			.06/.13		.13/.28		.11/.26
	4 yr	White	.06/.11	.10/.20			.07/.13		.12/.24		.12/.31
		Black	.04/.11	NA			.05/.11		.05/.21		.07/.23
		All	.06/.11	.08/.17			.06/.14		.11/.24		.11/.30
	3 yr	White	.08/.13	.14/.20			.09/.14		.16/.30		.19/.32
		Black	.07/.12	.08/.13			.07/.12		.12/.24		.14/.28
		All	.08/.13	.11/.16			.08/.14		.16/.29		.18/.31
73/07- 75/03	4 yr	White	.08/.14	.10/.21			.09/.15		.15/.27		.12/.26
		Black	.05/.12	NA			.05/.13		.12/.21		.15/.21
		All	.08/.13	.07/.13			.08/.14		.15/.27		.17/.24

Table 13

LOSS RATES AT FOUR AND TWELVE MONTHS
HIGH SCHOOL DIPLOMA GRADUATES MENTAL GROUPS I-III A

Acc Group	Race	3 Yr Term				4 Yr Term			
		CA-Europe 4 mo/12 mo	CA-Conus 4 mo/12 mo	CA-All 4 mo/12 mo	CA-Europe 4 mo/12 mo	CA-Conus 4 mo/12 mo	CA-All 4 mo/12 mo	CA-Conus 4 mo/12 mo	CA-All 4 mo/12 mo
71/01- 73/06	White	.07/.12	.05/.11	.07/.12	.09/.14	.06/.12	.07/.13		
	Black	.04/.12	.04/.12	.05/.15	.04/.07	.04/.12	.04/.11		
	All	.07/.12	.05/.11	.07/.12	.08/.13	.06/.12	.07/.12		
73/07- 75/03	White	.09/.15	.09/.13	.09/.13	.10/.15	.09/.14	.09/.14		
	Black	.09/.15	.06/.12	.07/.14	.05/.10	.05/.12	.05/.12		
	All	.09/.15	.08/.13	.09/.14	.09/.15	.08/.14	.08/.14		

Table 14
 LOSS RATES AT FOUR AND TWELVE MONTHS
 HIGH SCHOOL DIPLOMA GRADUATES MENTAL GROUPS I-IIIA
 Combat Arms Versus Non-Combat Arms

	3 Yr Term		4 Yr Term	
	Combat Arms 4 mo/12 mo	Other 4 mo/12 mo	Combat Arms 4 mo/12 mo	Other 4 mo/12 mo
71/01- White	.07/.12	.06/.12	.07/.13	.04/.09
73/06 Black	.05/.15	.05/.12	.04/.11	.06/.12
All	.07/.12	.06/.12	.07/.12	.04/.09
73/07- White	.09/.13	.08/.13	.09/.14	.07/.13
75/03 Black	.07/.14	.06/.12	.05/.12	.06/.09
All	.09/.14	.08/.13	.08/.14	.07/.12

Table 15

GENERALIZED MONTHLY LOSS RATES

Accession Group	Months of Service	3 Year Term			4 Year Term			3 Year Term			4 Year Term		
		Combat Arms	Other	Combat Arms	Other	Combat Arms	Other	Combat Arms	Other	Combat Arms	Other	Mental Group I-IIIA	Mental Group I-IV
HIGH SCHOOL DIPLOMA GRADUATES													
71/01- 73/06	13-24	.008	.008	.009	.007	.010	.008	.009	.006	.007	.009	.009	
	25-36	.007	.006	.008	.005	.007	.007	.005	.005	.005	.005	.008	
	37-48	.007	.005	.004	.004	.007	.007	.005	.005	.005	.005	.005	
73/07- 75/03	13-24	.007	.007	.008	.004	.007	.007	.008	.007	.007	.008	.004	
	25-36	.006	.006	.006	.003	.006	.006	.006	.006	.006	.006	.003	
	37-48	.005	.005	.002	.005	.005	.005	.005	.005	.005	.005	.002	
NON HIGH SCHOOL GRADUATES													
GEDs													
71/01- 73/06	13-24	.024	.030	.018	.012	.022	.020	.024	.020	.013	.016	.018	
	25-36	.014	.012	.016	.008	.008	.013	.013	.013	.005	.008	.010	
	37-48	.010	.009	.008	.008	.005	.005	.008	.008	.005	.008	.006	
73/07- 75/03	13-24	.016	.016	.016	.013	.017	.021	.017	.017	.010	.014	.017	
	25-36	.010	.010	.010	.008	.008	.010	.010	.010	.005	.010	.010	
	37-48	.007	.007	.007	.007	.005	.005	.005	.005	.005	.005	.005	

Table 16
 EXPECTED SERVICE TIME
 ALL ENLISTMENT OPTIONS BY EDUCATION/MENTAL GROUP
 (CONTINUATION RATES SUMMED OVER FIRST 48 MONTHS)

Accession Group	Term	Race	HSI-IIIA	HSIV	HS All	GED	NHS
71/01- 73/06	3	White	2.77	2.64	2.76	2.17	2.23
		Black	2.89	2.92	2.91	2.30	2.39
		All	2.80	2.80	2.80	2.19	2.27
	4	White	3.22	2.89	3.15	2.58	2.25
		Black	3.34	NA	3.25	2.62	2.64
		All	3.25	2.89	3.18	2.59	2.35
	3	White	2.76	2.60	2.75	2.08	2.02
		Black	2.84	2.79	2.81	2.24	2.34
		All	2.78	2.69	2.76	2.11	2.14
	4	White	3.23	3.06	3.22	2.66	2.49
		Black	3.31	NA	3.31	2.83	2.85
		All	3.25	3.06	3.24	2.70	2.66

general, the differences between the two eras are very small, especially for high school diploma graduates. Table 17 shows, with the two eras combined, that the gain in Expected Service Times for combat arms enlistments of four instead of three years is .35-.40 years. This is the minimum gain that could be attributed to the additional year of enlistment; applying equation (5) over a time longer than 48 months will increase this difference since the reenlistment rates for four year enlistees appear (in Appendix D) to be about 30 percent higher than for comparable three year enlistees.

Table 18 compares Expected Service Times for combat arms and non-combat arms enlistees by race and term of enlistment. No uniform conclusions can be drawn from this table except that the gain in expected service from the additional year of enlistment for non-combat arms enlistees is about .55, substantially higher than the gain for combat arms enlistees.

Table 17
 EXPECTED SERVICE TIME
 HIGH SCHOOL DIPLOMA GRADUATES/MENTAL GROUP I-IIIA
 COMBAT ARMS BY LOCATION OPTION
 ALL ACCESSION GROUPS COMBINED
 (CONTINUATION RATES SUMMED OVER FIRST 48 MONTHS)

Race	3 Year Term			4 Year Term		
	CA-Europe	CA-Conus	CA-All	CA-Europe	CA-Conus	CA-All
White	2.72	2.88	2.81	3.07	3.19	3.16
Black	2.82	3.01	2.88	3.23	3.29	3.28
All	2.72	2.89	2.81	3.10	3.24	3.21

Table 18
 EXPECTED SERVICE TIME
 HIGH SCHOOL DIPLOMA GRADUATES/MENTAL GROUP I-IIIA
 COMBAT ARMS VERSUS NON-COMBAT ARMS
 (CONTINUATION RATES SUMMED OVER FIRST 48 MONTHS)

Race	3 Year Term		4 Year Term	
	CA-All	Other	CA-All	Other
White	2.81	2.74	3.16	3.31
Black	2.88	2.92	3.28	3.24
All	2.81	2.78	3.21	3.31

4. ANALYSIS OF LOSSES FROM COMBAT ARMS TO OTHER ARMY SKILLS

OBJECTIVE

The purpose of this task is to determine the extent to which combat arms enlistees are lost to other skills, either by a formal change in primary MOS or by assignment to a non-combat arms duty MOS.

BACKGROUND

In Chapter III continuation rates were developed for a wide variety of enlistee classifications. These measure retention in the Army as a whole and do not directly measure continuation in the particular skill that the enlistee chose for training.

Since the enlistment bonuses are paid for anticipated service in a particular skill (or class of skills) an analysis of what the bonuses accomplish for the Army requires adjustment of the continuation rates to reflect losses from the bonus skills. This task concentrated on the combat arms enlistees since the non-combat arms bonus enlistment program was too new to permit any significant analysis of loss tendencies from those skills.

METHODOLOGY

To accomplish the requirements of this task, an extract was taken from the same enlistment file used in the Continuation Rate analysis. This extract consisted of all combat arms enlistees whose accession dates were between June 1972 and October 1974, about 83,000 enlistments. These records were then compared with a modified form of the June 30, 1975 Enlisted Master File which provided, for those still in the Army, the Primary MOS (PMOS) and Duty MOS (DMOS) as of that date and also identified reenlistees.

The enlistees were cross-classified in the following ways:

- o Education
 - High school diploma graduate
 - GED
 - Other non-high school graduate
- o Race
 - Black
 - White and other
- o Term of enlistment
 - Three years
 - Four years
- o Enlistment option
 - Europe
 - Other

For each classification of enlistees the following statistics were calculated for each month's enlistees:

- o Number of enlistees
- o Loss rate from the Army
- o Loss rate from combat arms to other skills in the PMOS
- o Loss rate from combat arms to other skills in the DMOS
- o PMOS loss rate relative to those still in the Army
- o DMOS loss rate relative to those still in the Army and still having a combat arms PMOS.

These statistics were calculated for those who had not reenlisted, for those who had reenlisted and for the two groups combined.

The detailed results of this analysis are given in Appendix F.

ANALYSIS OF RESULTS

Loss from Combat Arms in the Primary MOS

The trends in adjusted PMOS loss rates (loss rates as a function of those still in the Army) for various pairs of classifications of high school diploma graduates are shown in Figs. 6 to 12 for combined reenlistees and non-reenlistees. While the loss rates curves are not monotonic, it is clear that the slopes of fitted lines would be positive; that is, there does seem to be a significant increase in the monthly PMOS loss rates over increasing length of service.

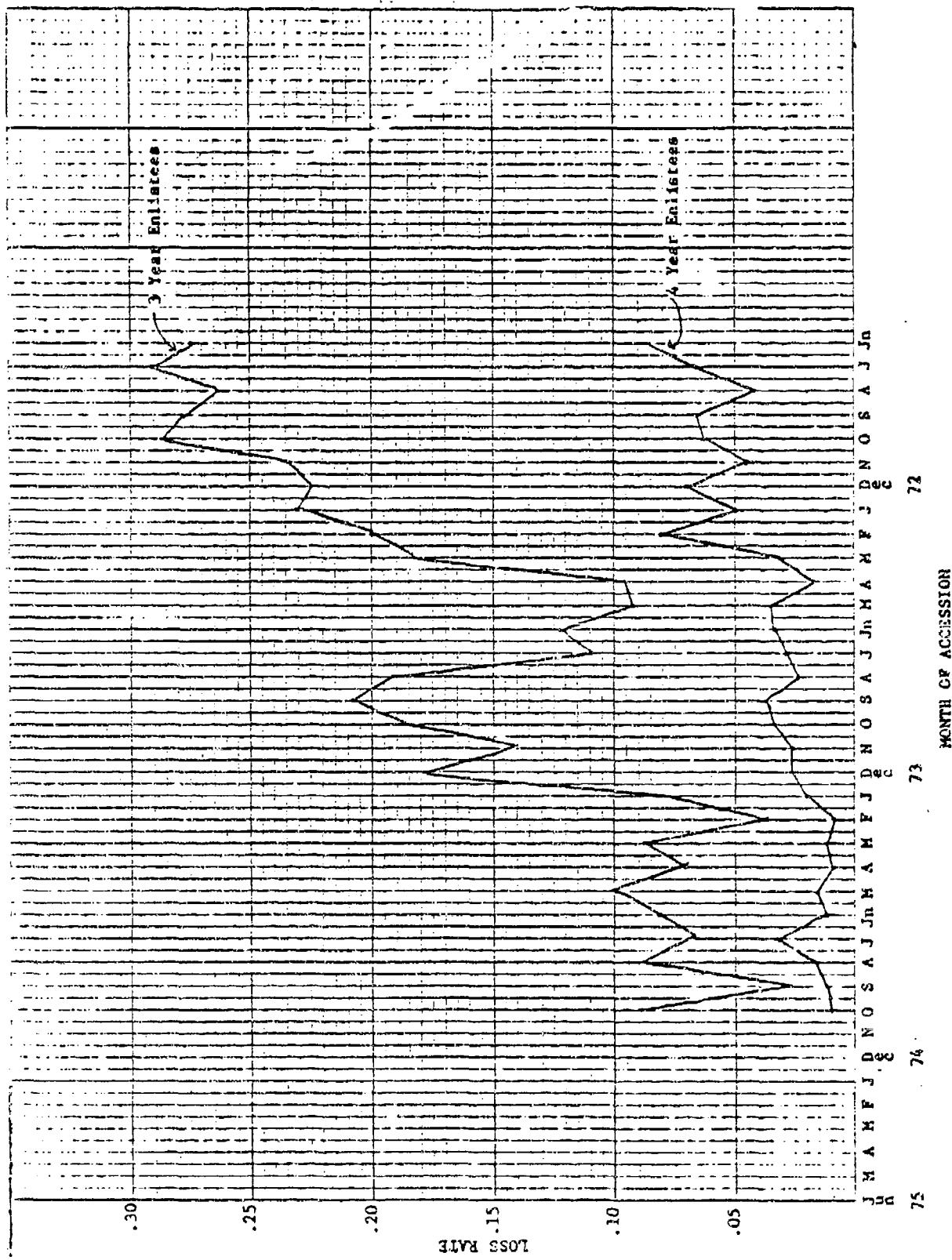


FIG. 6—Monthly Loss Rates from Combat Arms to a Non-Combat Arms PMOS
White, High School Graduates, Other than Europe Option

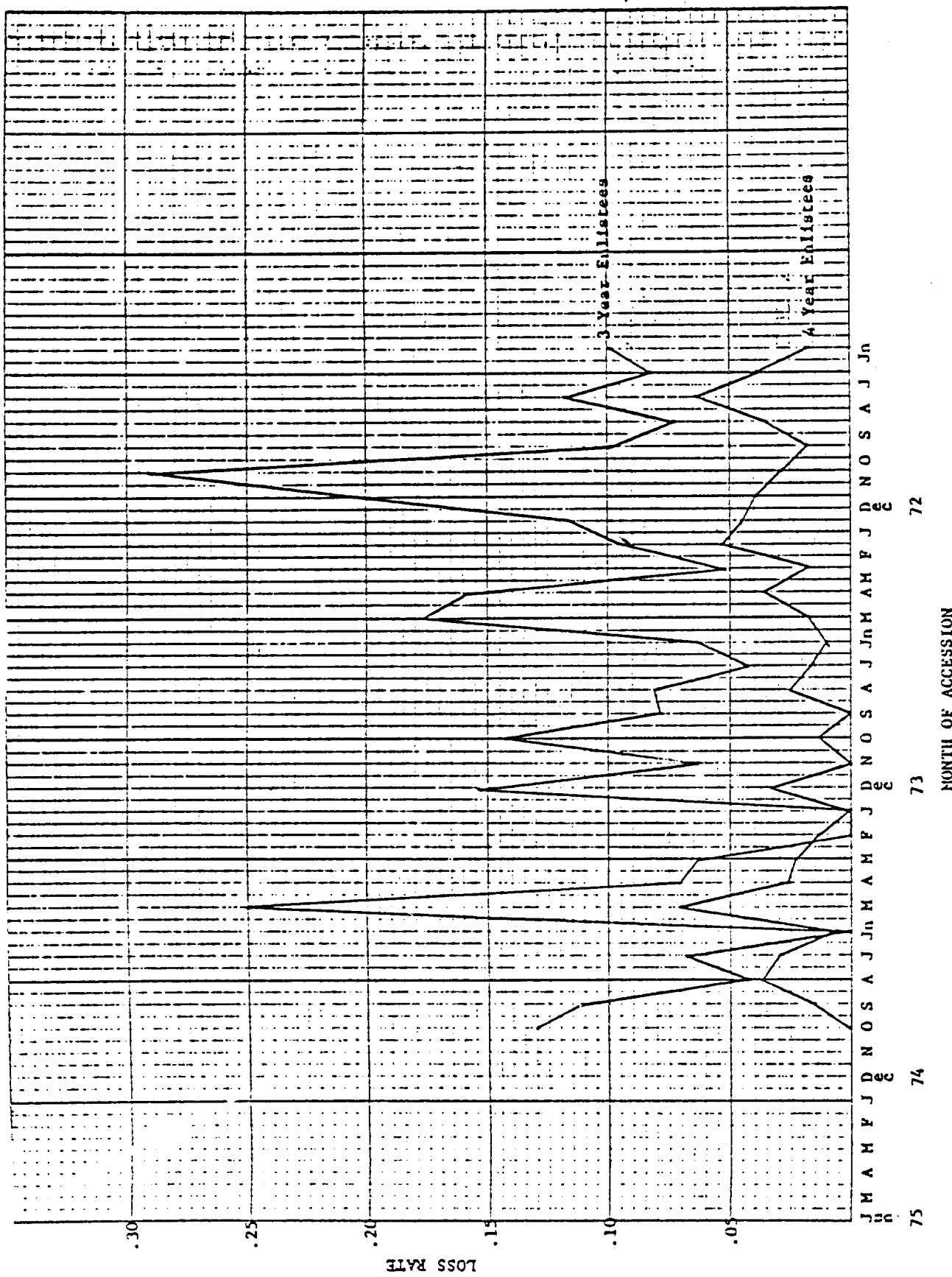


Fig. 7.—Monthly Loss Rates from Combat Arms to a Non-Combat Arms PMOS White, High School Graduate, Europe Option

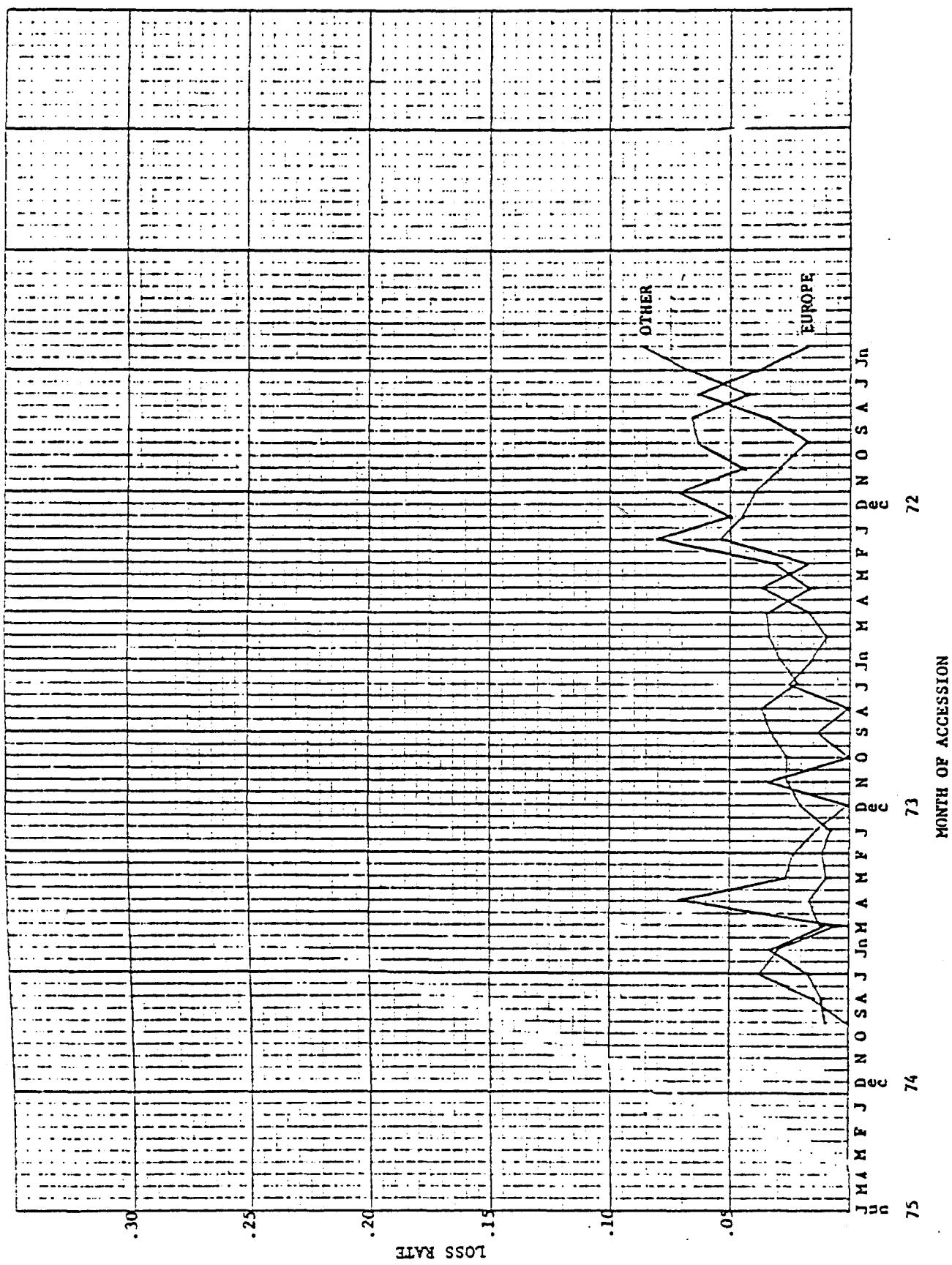


Fig. 8 — Monthly Loss Rates from Combat Arms to a Non-Combat Arms PMOS
White, High School Graduate, Four Year Enlistees

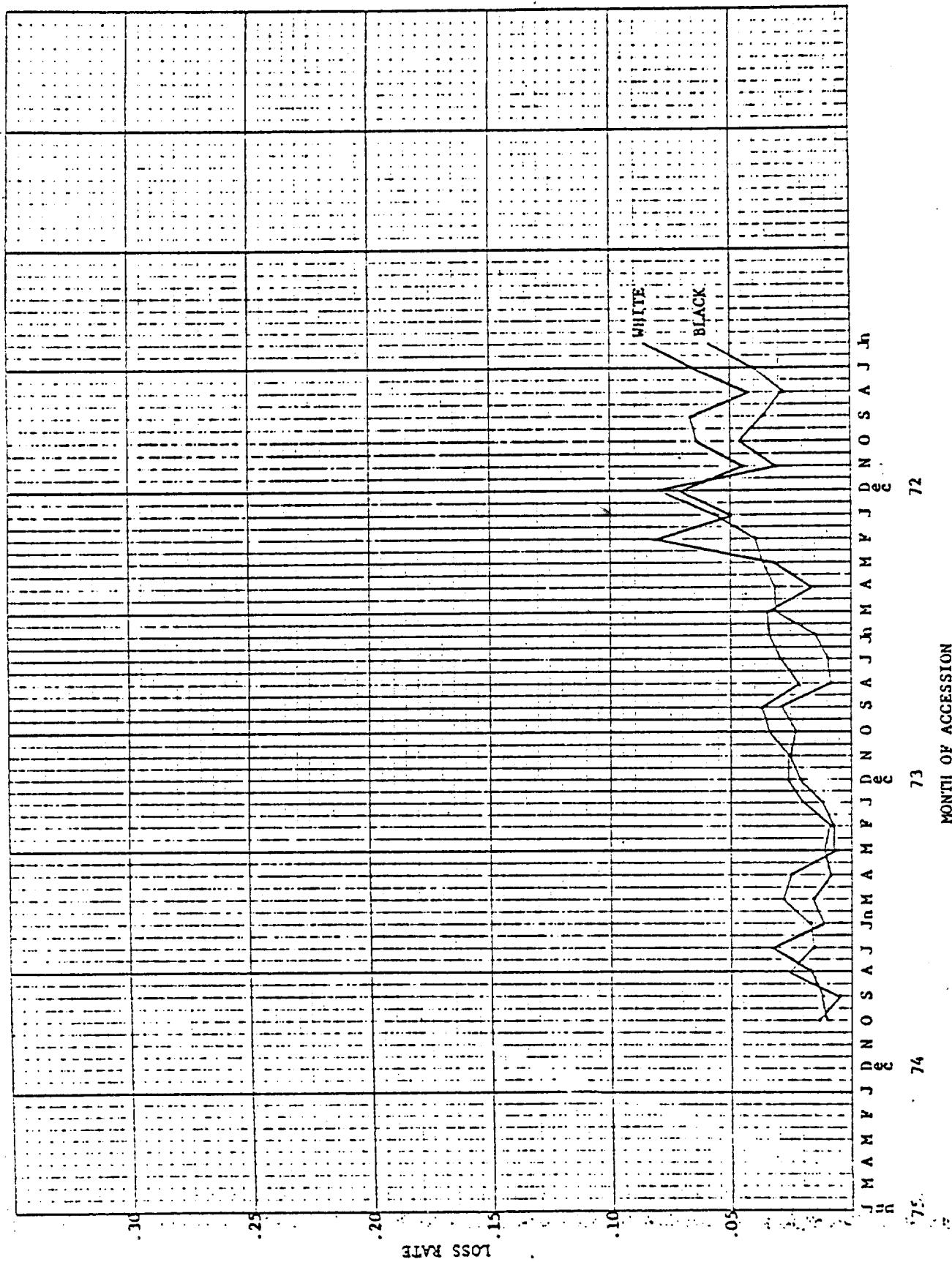


FIG. 9 --Monthly Loss Rates from Combat Arms to a Non-Combat Arms MOS
High School Graduates, Four Year Term Other Than Europe Option

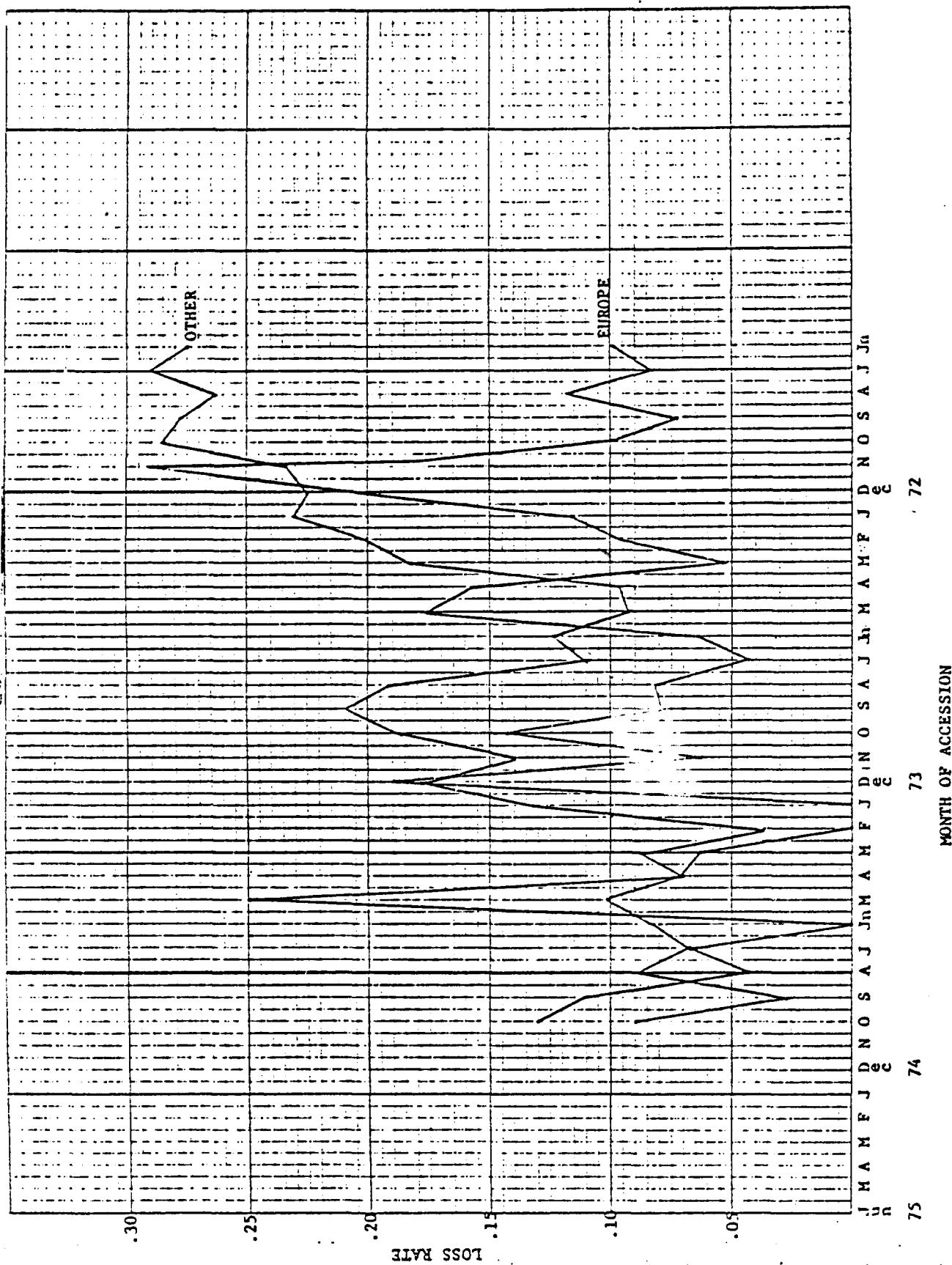


Fig. 10--Monthly Loss Rates from Combat Arms to a Non-Combat Arms PMOS
White, High School Graduate, Three Year Term

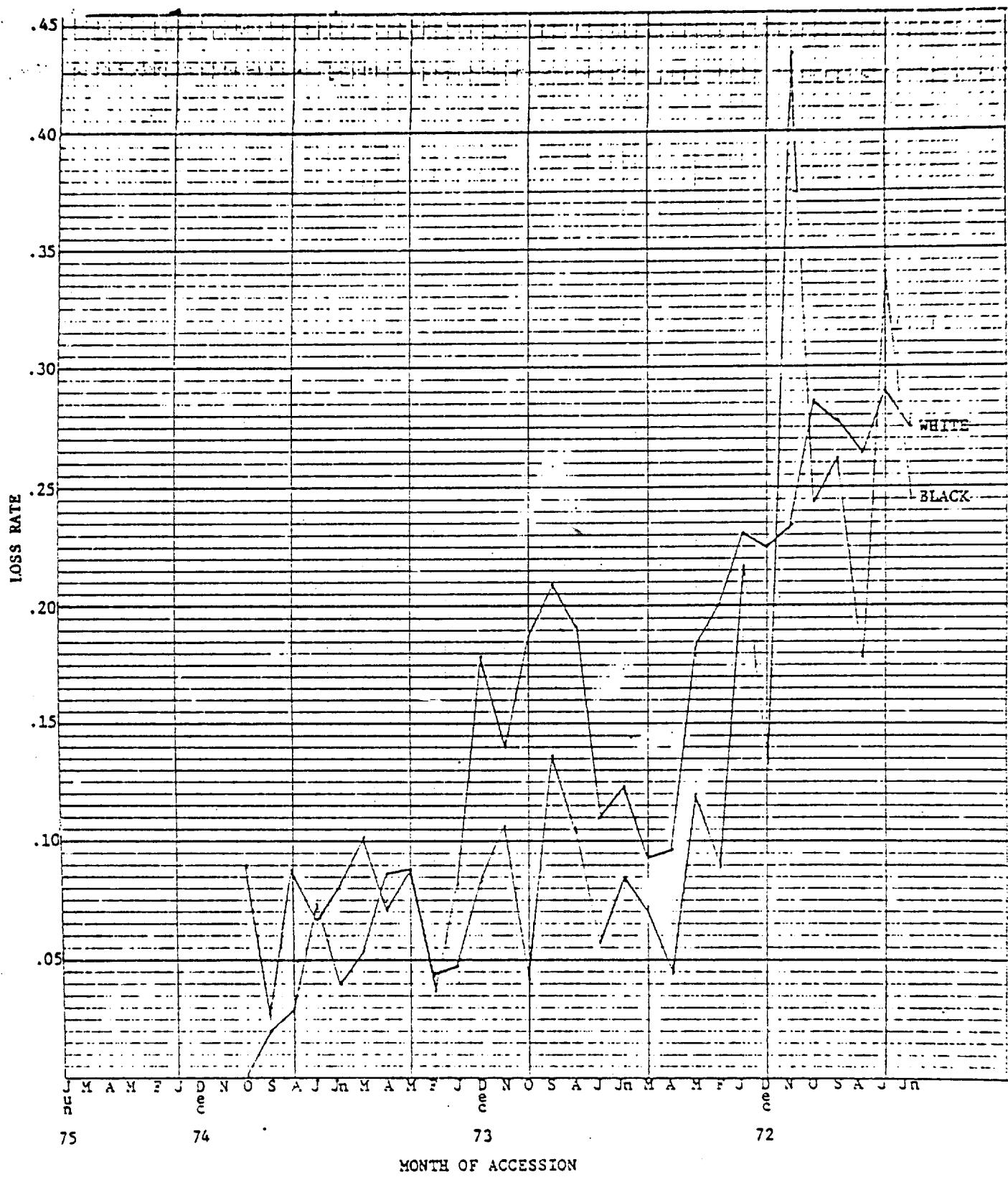


Fig.11 —Monthly Loss Rates from Combat Arms to a Non-Combat Arms PMOS
High School Graduate, Three Year Term Other Than Europe Option

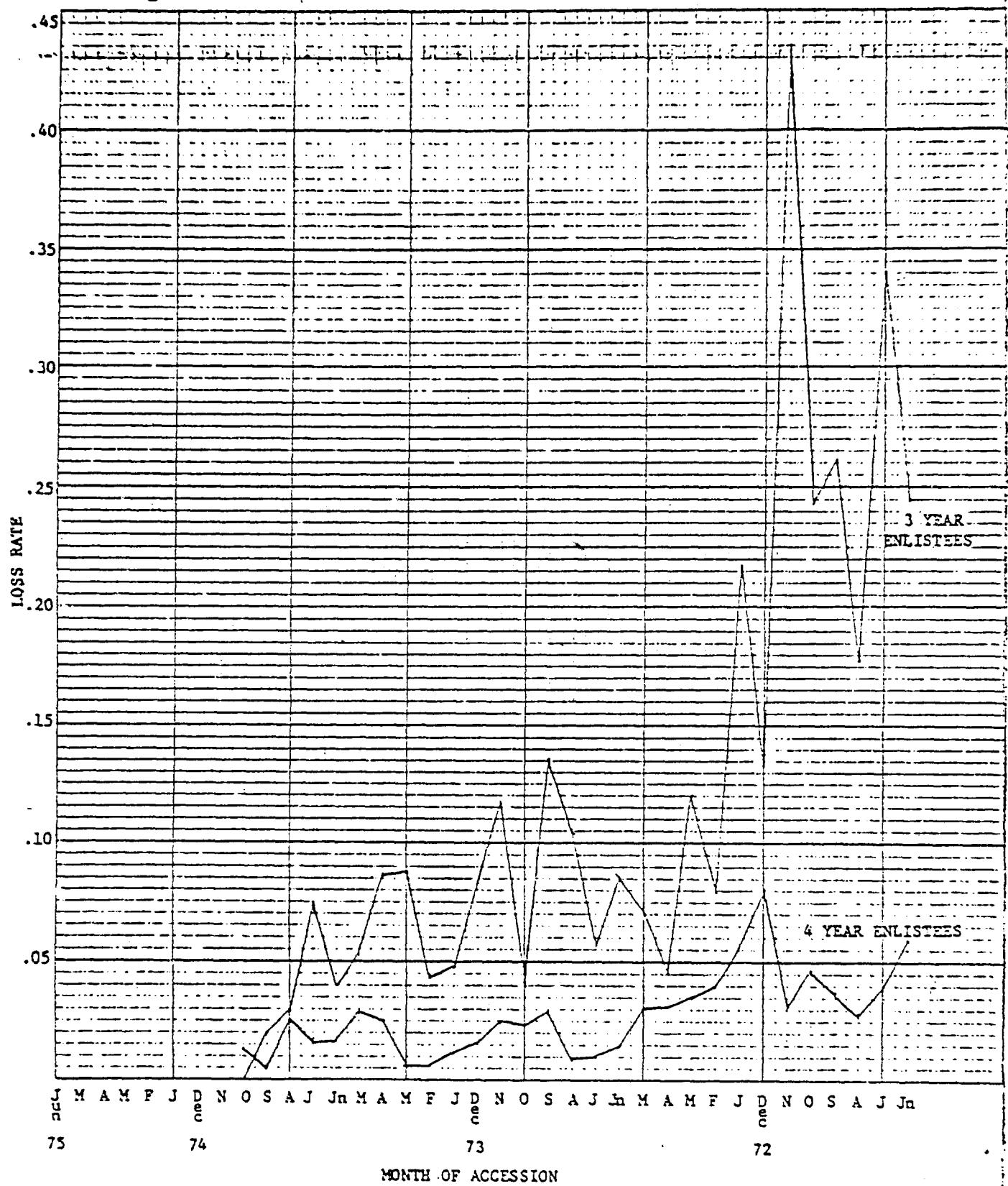


Fig. 12—Monthly Loss Rates from Combat Arms to a Non-Combat Arms PMOS
High School Graduate, Black Other Than Europe Option

Several significant differences among the various classifications of enlistees are also evident. The PMOS loss rates for three year enlistees are uniformly greater than for four year enlistees. It is also seen that the black PMOS loss rates are somewhat lower than the white and that the PMOS loss rate for enlistees with Europe options are somewhat lower than for combat arms enlistees with other options.

To place these PMOS loss rates on more concrete numerical terms, a weighted average loss rate for enlistees having June 1972 through February 1973 accession dates was calculated. The results are shown in Table 19 and reinforce the conclusions drawn from the figures. Note that while there is little difference between reenlistees and non-reenlistees with three year terms, there is a substantial difference for those with four year terms.

To provide a means of adjusting the continuation rates of Chapter III to account for PMOS losses, the rates of Table 19 can be transformed into estimates of a monthly conditional PMOS loss rate if the conditional PMOS loss rate is assumed constant over time. That is, if it is assumed that the PMOS losses in a given month of service as a fraction of the enlistees present at the beginning of that month with combat arms PMOSs is constant over time. With this assumption:

$$\lambda_p = 1 - (1 - \lambda_j)^{1/32} \quad (8)$$

where λ_p is the conditional monthly PMOS loss rate, λ_j is the weighted loss rate from Table 19 and 32 is the number of months from the midpoint of the

Table 19
PRIMARY MOS LOSS RATES FROM COMBAT ARMS JUNE 1972 THROUGH
FEBRUARY 1973 ENLISTEES STATUS AS OF JUNE 30, 1975
HIGH SCHOOL DIPLOMA GRADUATES

Race	Term of Enlistment	Have Not Reenlisted		Have Reenlisted	
		Europe	Other	Europe	Other
White	3	.122	.268	.100	.262
	4	.031	.059	.059	.078
Black	3	.173	.265	N/A	.219
	4	.036	.043	N/A	.051
All	3	.132	.268	.100	.249
	4	.032	.054	.059	.070

time period used to construct Table 19 to June 1975. Values of λ_p are given in Table 20.

Losses from Combat Arms in the Duty MOS

Service in a duty MOS outside combat arms is different from a change in PMOS to a skill outside combat arms. The duty MOS change may be expected to be temporary; the loss to combat arms not usually permanent. With this in mind, it is not surprising that the analysis yields duty MOS loss rates for high school diploma graduates which appear to be nearly constant over time, as can be seen in Figs. 13-18. As with the PMOS loss rates, the DMOS loss rates appear to be higher for the three year enlistees. There is little difference between races or enlistment options and no consistent difference between reenlistees and non-reenlistees. Table 21 gives average DMOS loss rates by race, term of enlistment and enlistment option. These loss rates are constant fractions of the enlistees in the Army with combat arms PMOS at any point on the length of service line.

Adjusted Combat Arms Continuation Rates

With the results of Tables 20 and 21, it is possible to modify the continuation rate functions of Chapter 3 to reflect continuation experience in combat arms. The modified continuation rate will be:

$$C_{i,ca} = C_i (1 - \lambda_p)^i (1 - \lambda_d) \quad (9)$$

where λ_d is the DMOS loss rate as in Table 21. Modified continuation rate functions for the Europe and other enlistment options and three and four year enlistment terms are shown in Figs. 19-22.

The insights provided by these continuation functions can be augmented by displaying the disposition of all enlistees at some fixed point in the term of service. Figs. 23-26 show such dispositions for the same classifications as Figs. 19-22, at the 30th month of service.

Expected Service Time in Combat Arms

Table 17, Chapter 3, provided estimates of expected service time in the Army for various categories of combat arms enlistees. The data developed in Chapter IV on PMOS and DMOS losses now permits the extension of some of the data in Table 17 to reflect expected service times in combat

Table 20
PMOS CONDITIONAL MONTHLY LOSS RATES
HIGH SCHOOL DIPLOMA GRADUATES
COMBAT ARMS ENLISTEES

Race	Term of enlistment	Have not reenlisted		Have reenlisted	
		Europe	Other	Europe	Other
White	3	.004	.010	.003	.009
	4	.001	.002	.002	.002
Black	3	.005	.009	.004	.008
	4	.001	.001	.002	.002
All	3	.004	.010	.003	.009
	4	.001	.002	.002	.002

Table 21
DMOS MONTHLY LOSS RATES
HIGH SCHOOL DIPLOMA GRADUATES
COMBAT ARMS ENLISTEES

Race	Term of Enlistment	Option	
		Europe	Other
White	3	.095	.120
	4	.070	.060
Black	3	.105	.105
	4	.090	.050
All	3	.097	.117
	4	.074	.058

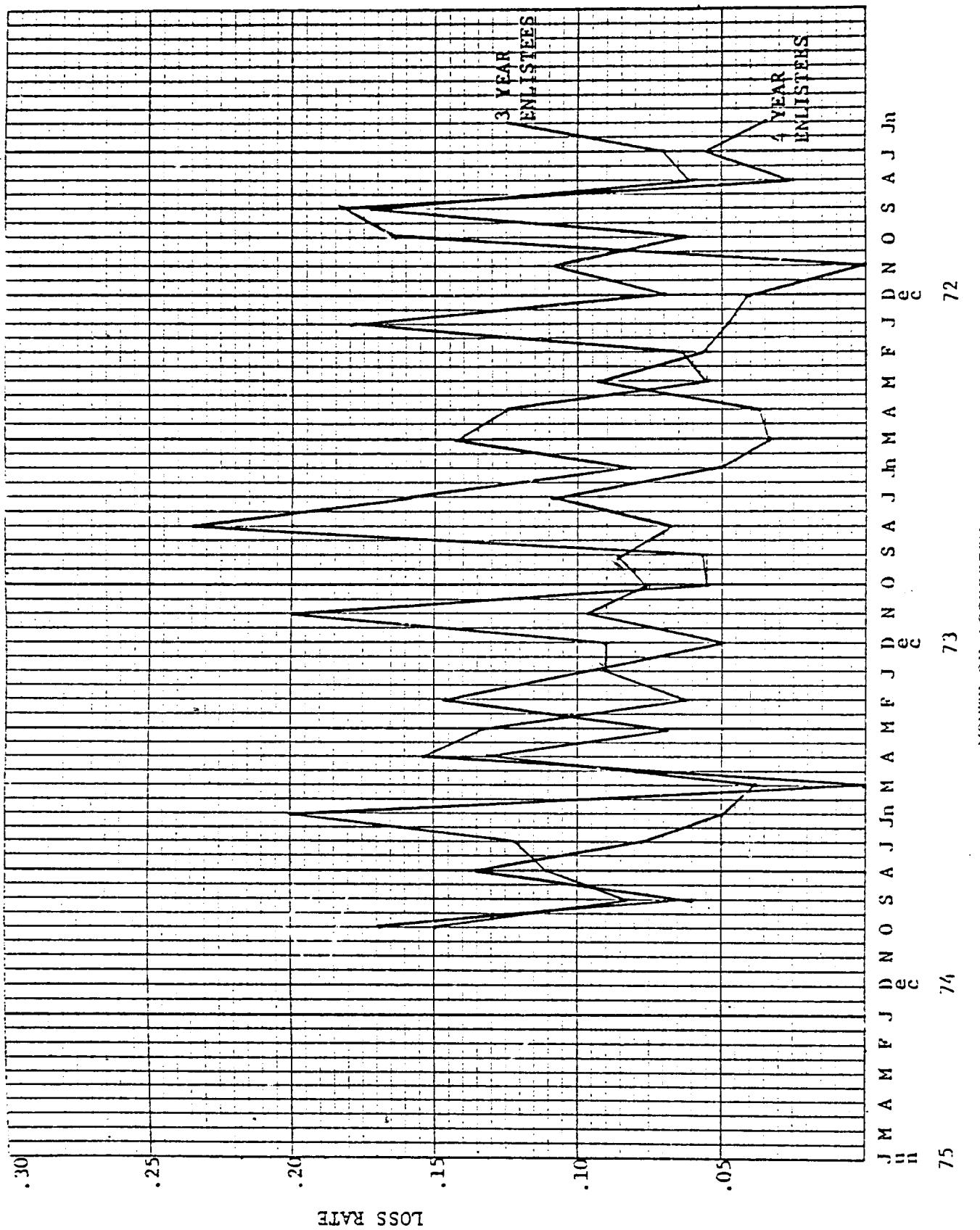
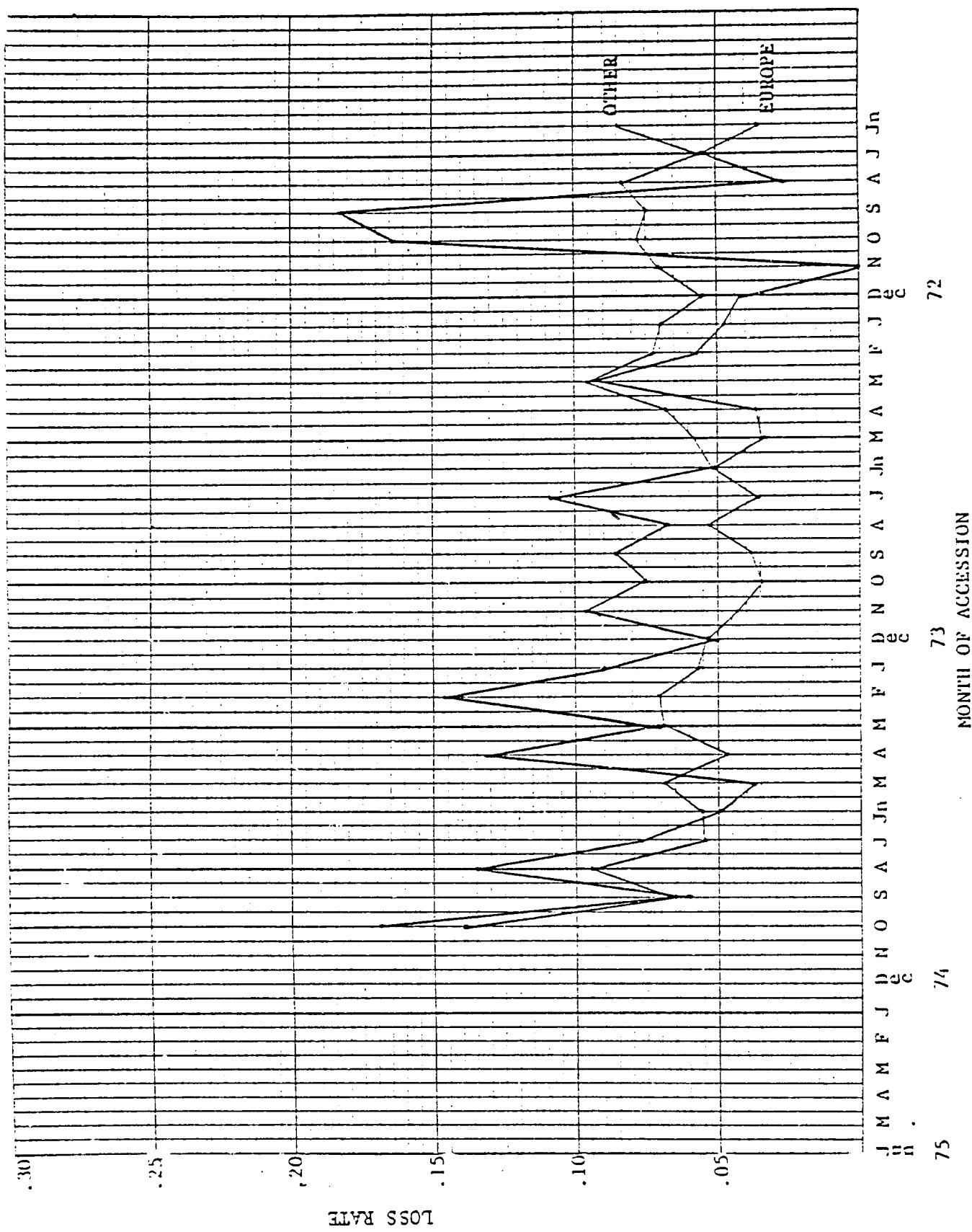
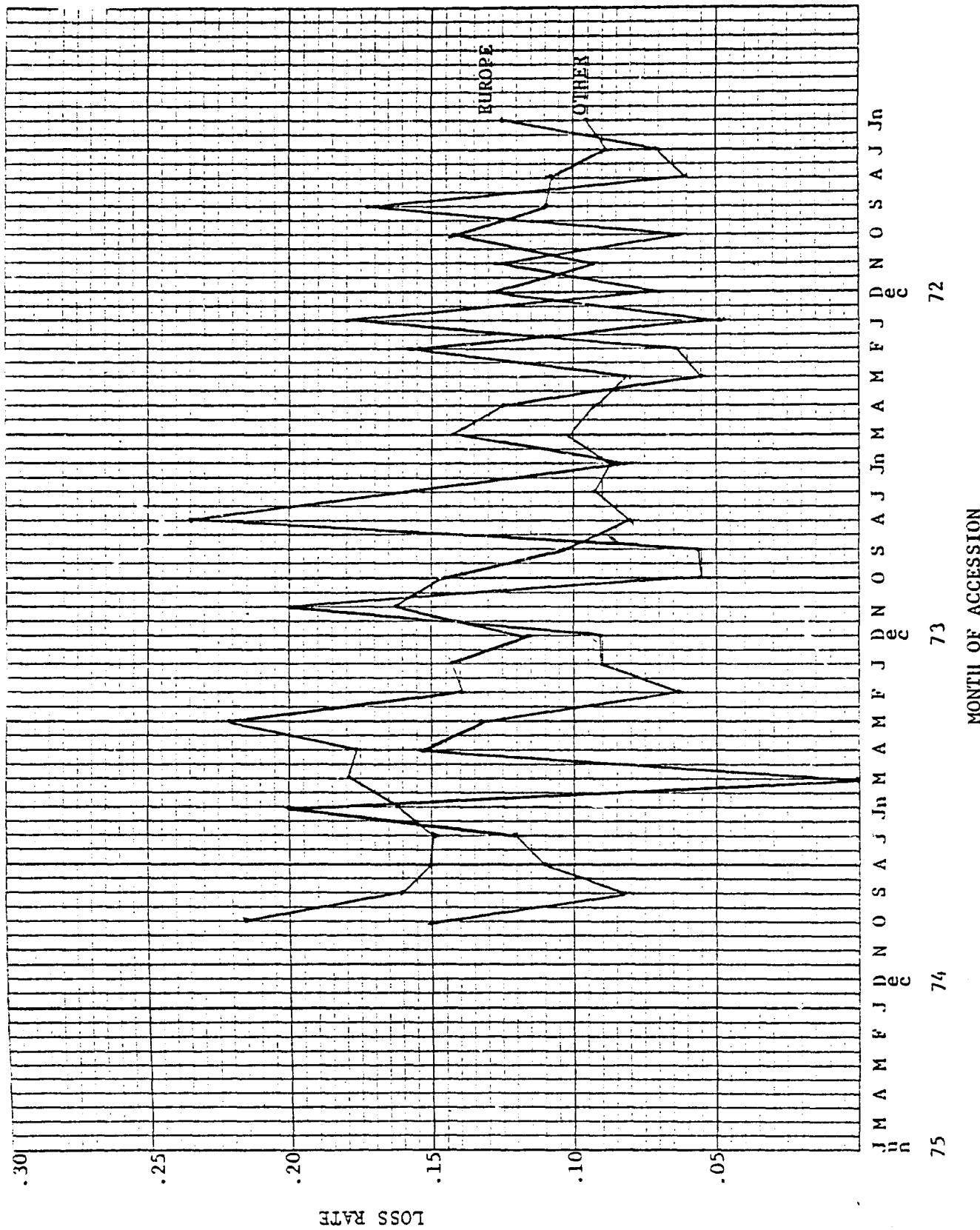
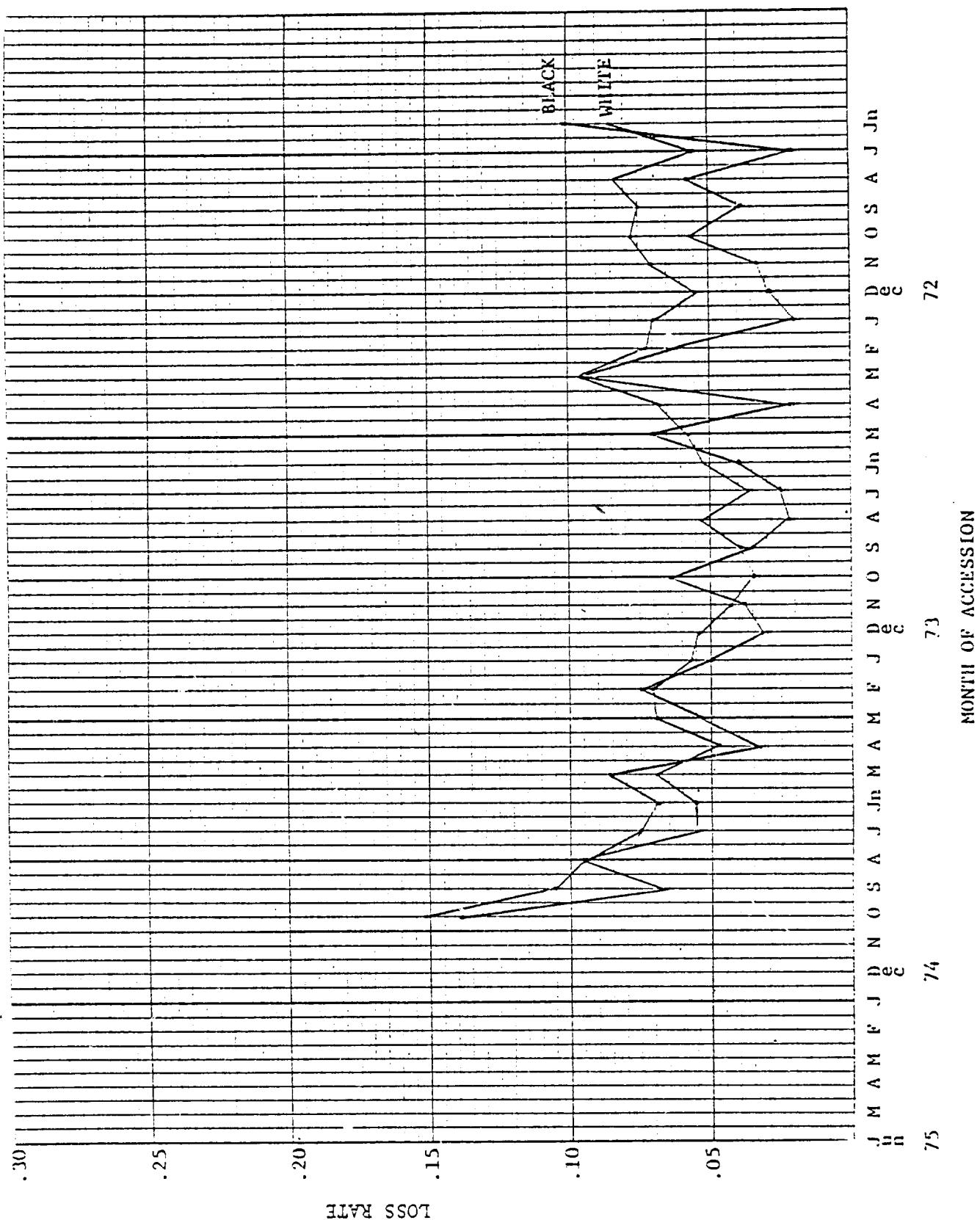
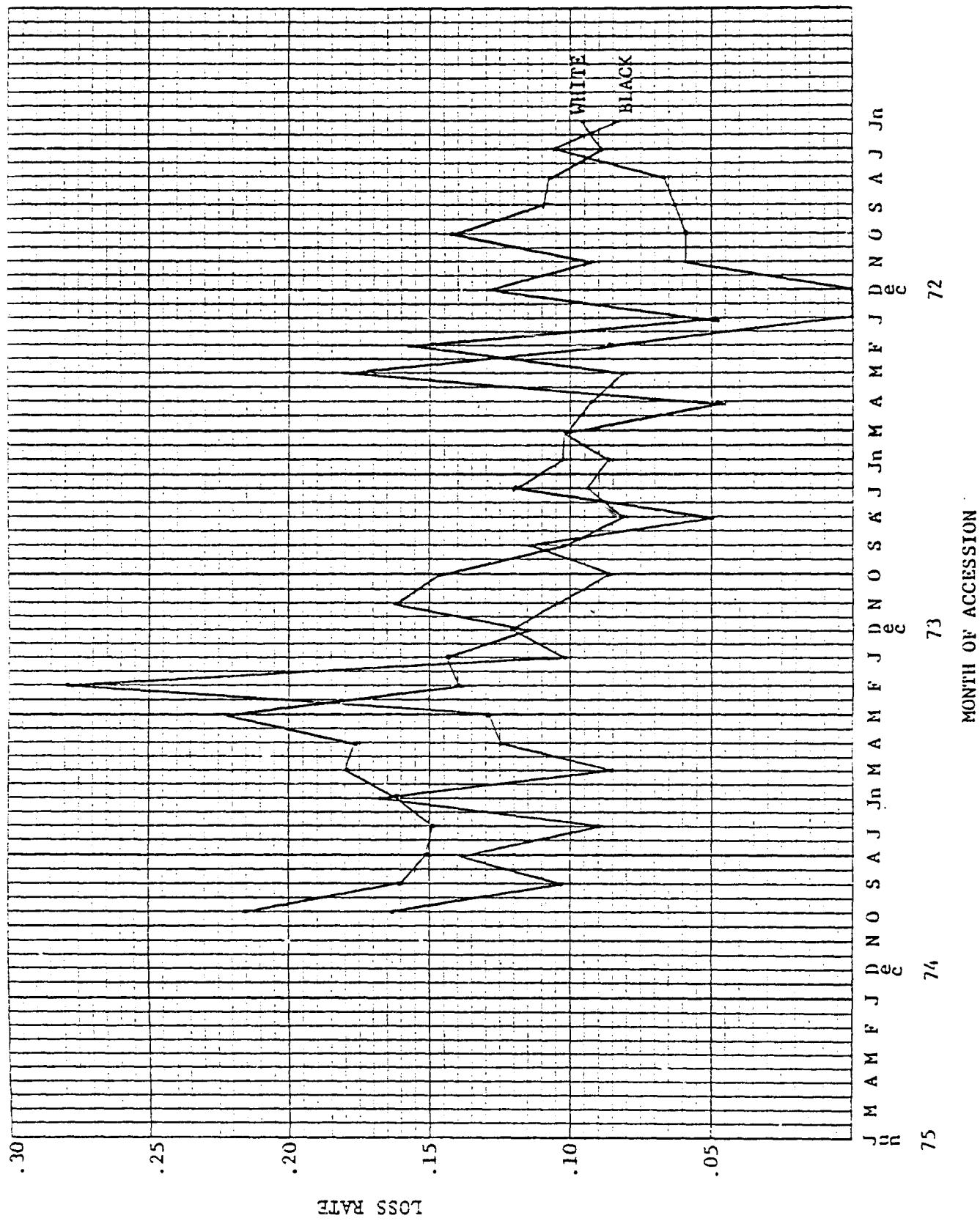


Fig. 13 - Loss Rates from Combat Arms to Non-Combat Arms Duty MOS
White, High School Graduate, Europe Option









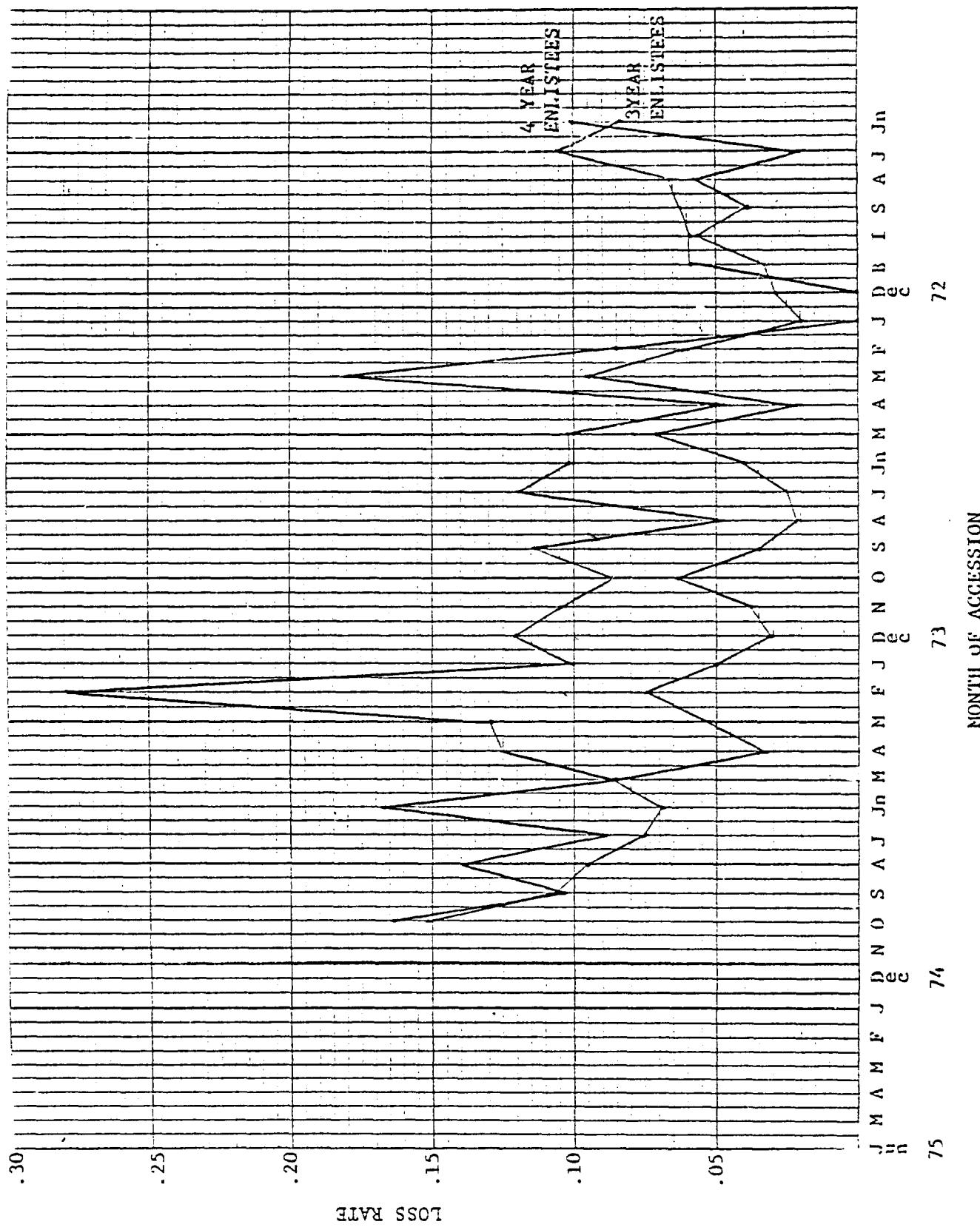


Fig. 18--Loss Rates from Combat Arms to Non-Combat Arms Duty MOS
 Black High School Graduates Other Than Europe Option

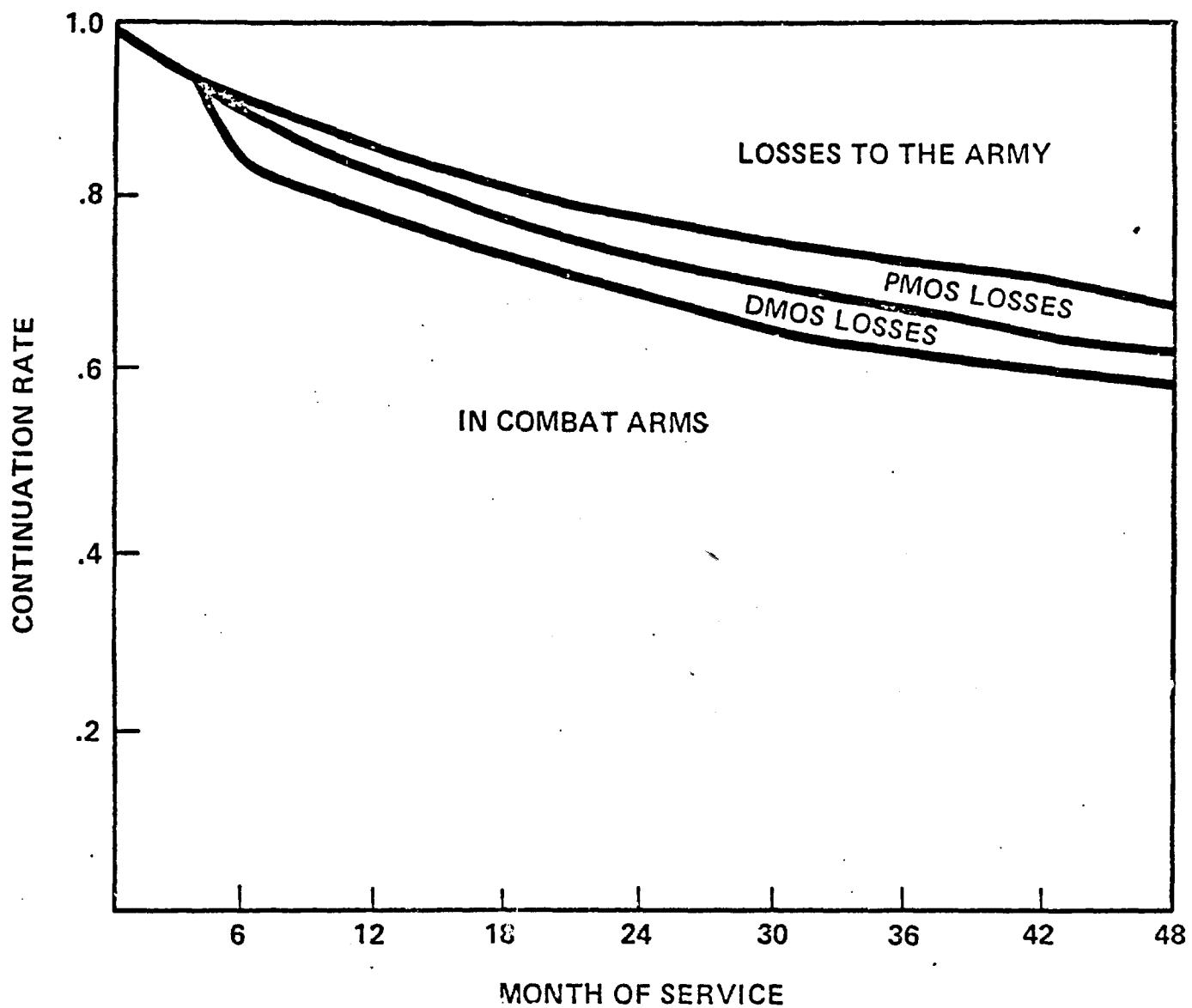


Fig. 19 - Continuation Function for Service in Combat Arms
Mental Group I-III A, High School Diploma Graduates
Four Year Term, Other Than Europe Option

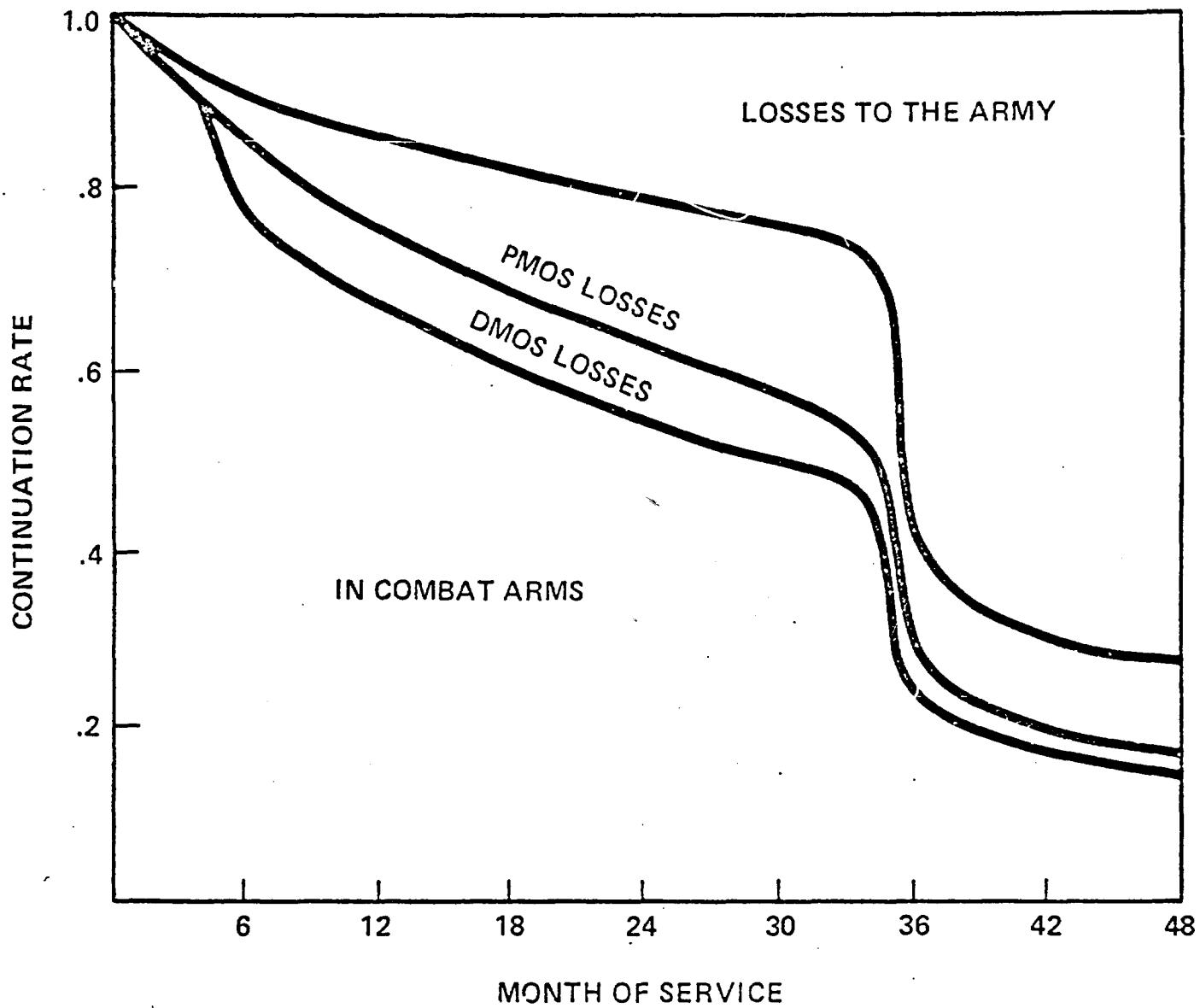


Fig. 20—Continuation Function for Service in Combat Arms
Mental Group I-IIIA, High School Diploma Graduates
Three Year Term, Other Than Europe Option

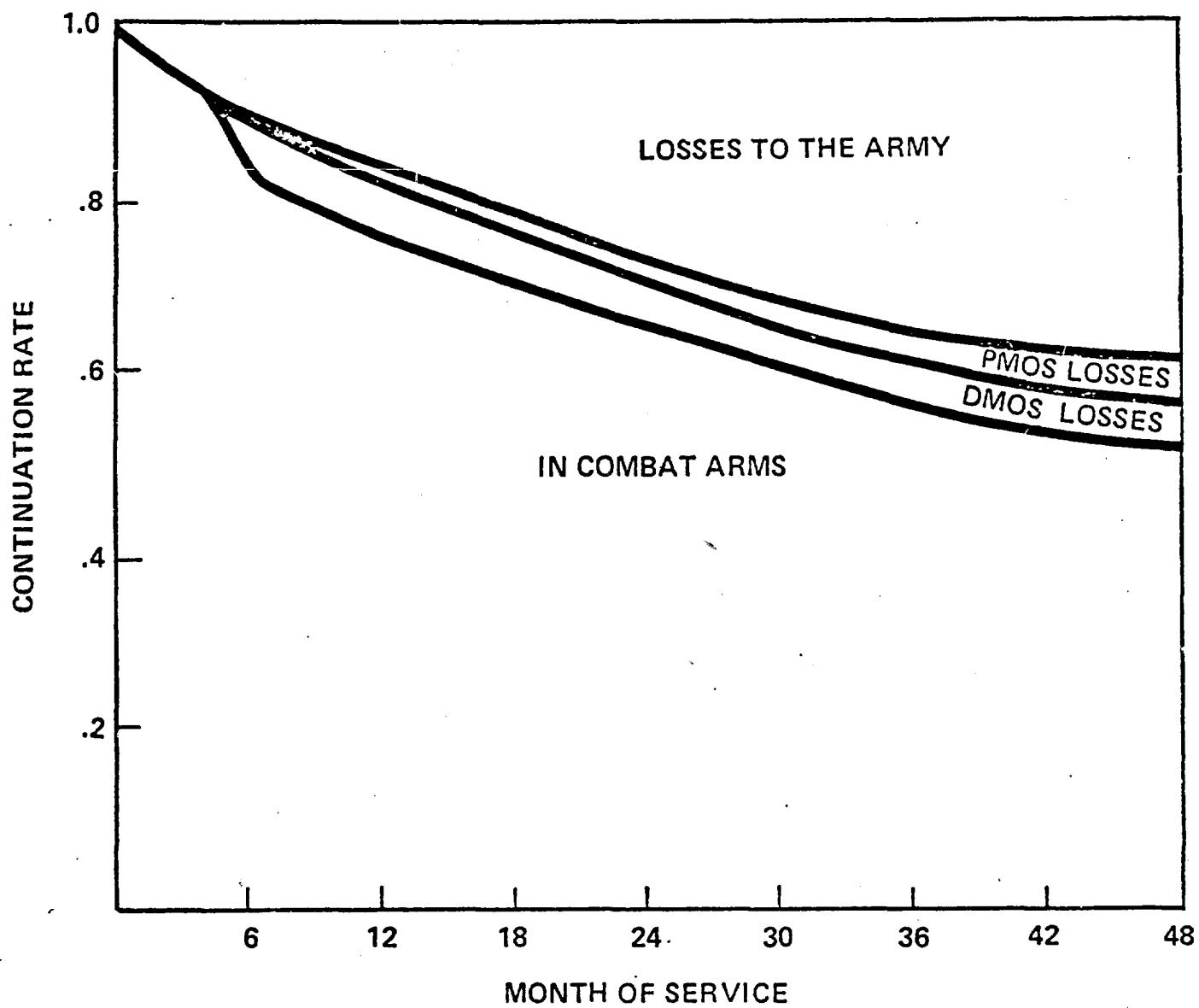


Fig. 21 — Continuation Function for Service in Combat Arms
Mental Group I-III A, High School Diploma Graduates
Four Year Term, Europe Option

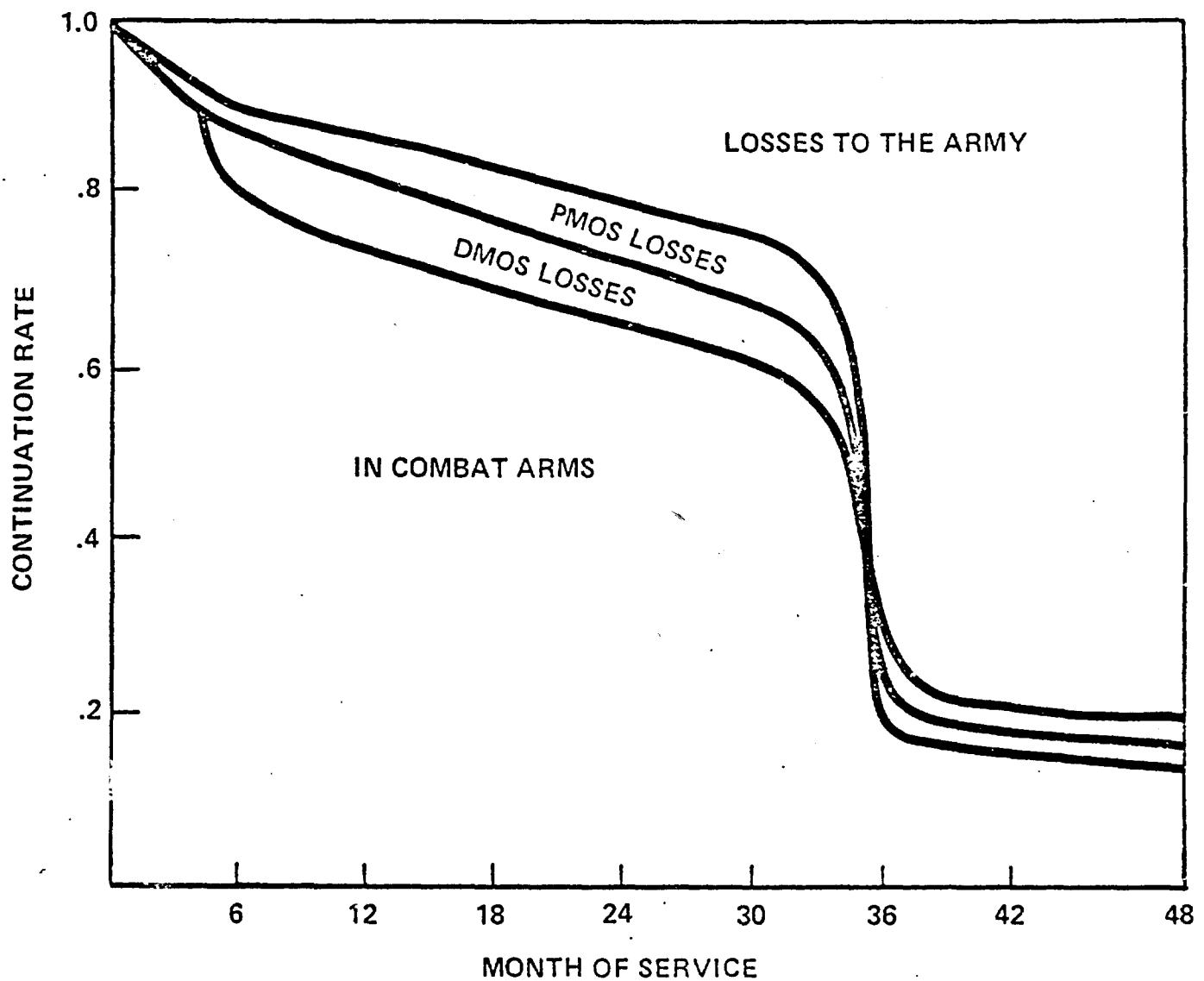


Fig. 22—Continuation Function for Service in Combat Arms
Mental Group I-III A, High School Diploma Graduates
Three Year Term, Europe Option

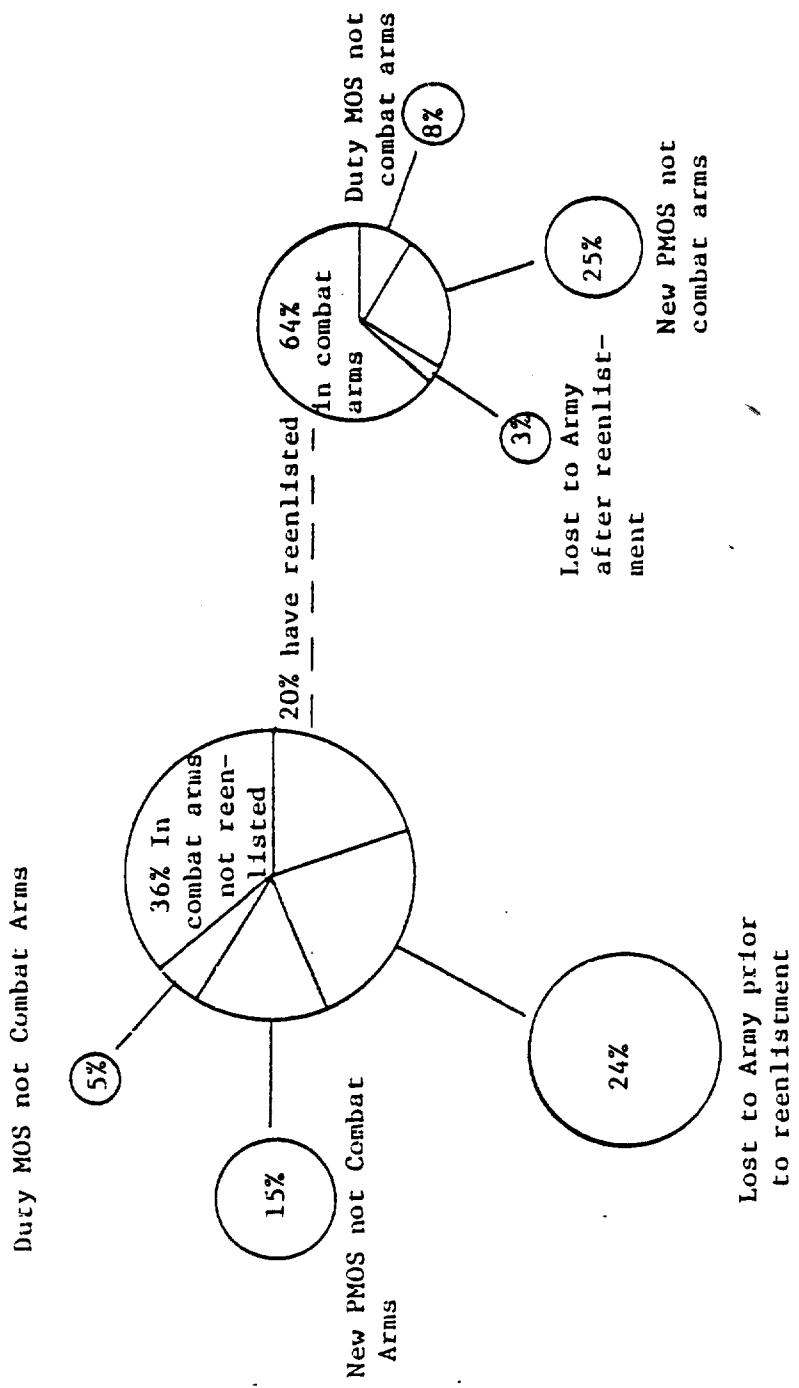


Fig. 23.—Status of Enlistees with Combat Arms Options 30 Months After Enlistment
 High School Diploma Graduates,
 Three Year Enlistees with Other Than Europe Option

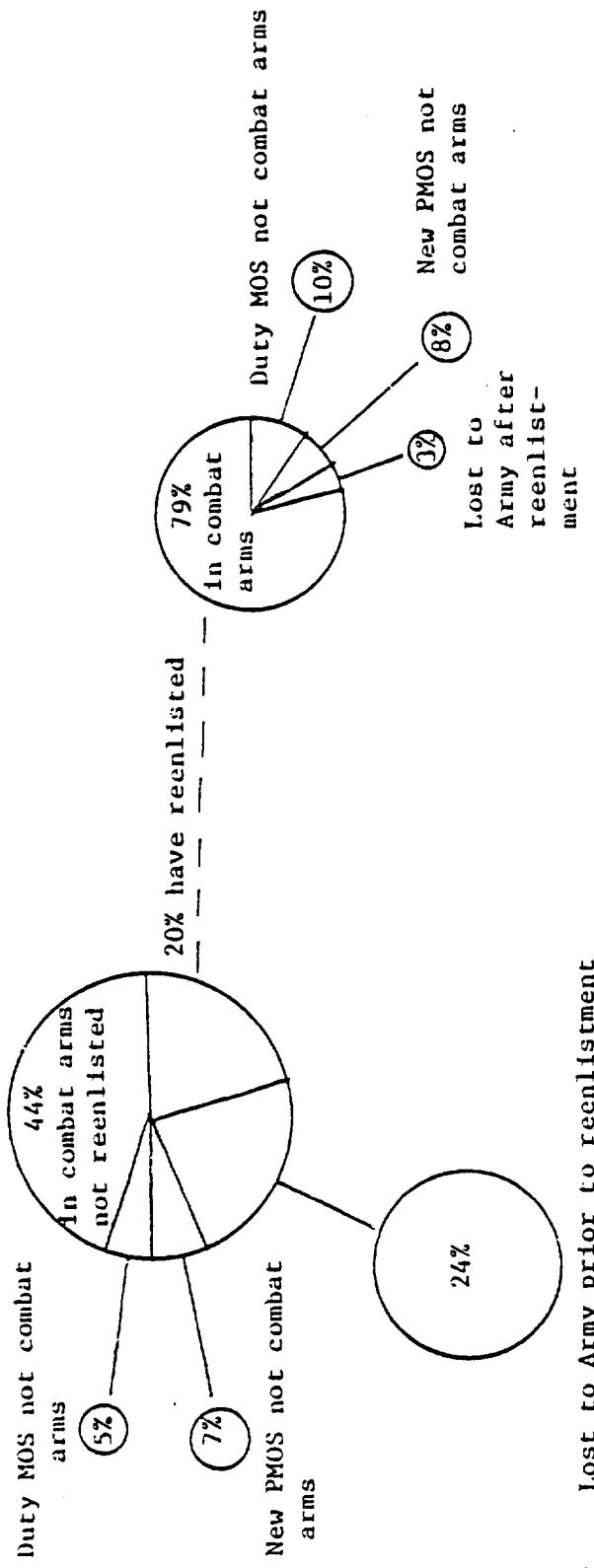


Fig. 24.—Status of Enlistees with Combat Arms Options 30 Months After Enlistment
 High School Diploma Graduates,
 Three Year Enlistees with Europe Option

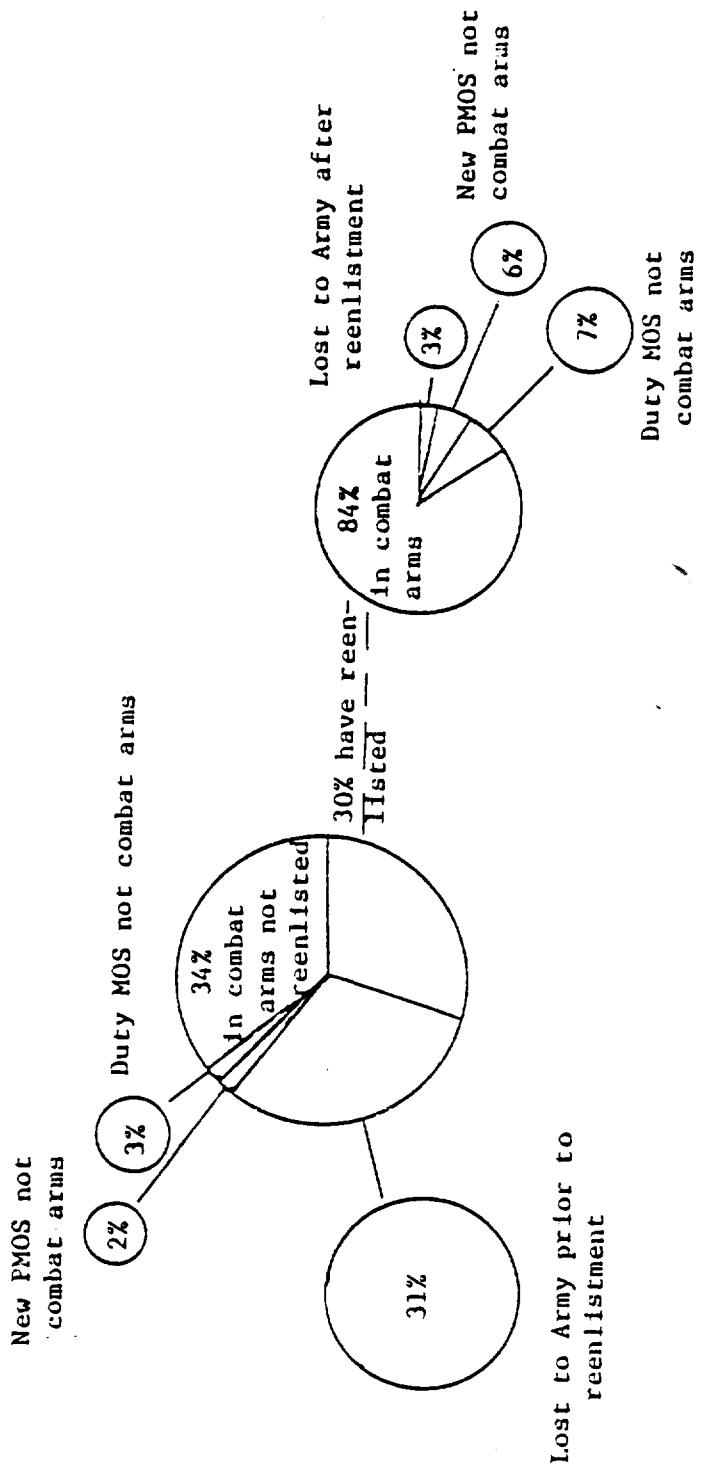


Fig. 25.—Status of Enlistedees with Combat Arms Options 30 Months After Enlistment
 High School Diploma Graduates,
 Four Year Enlistedees with Europe Option

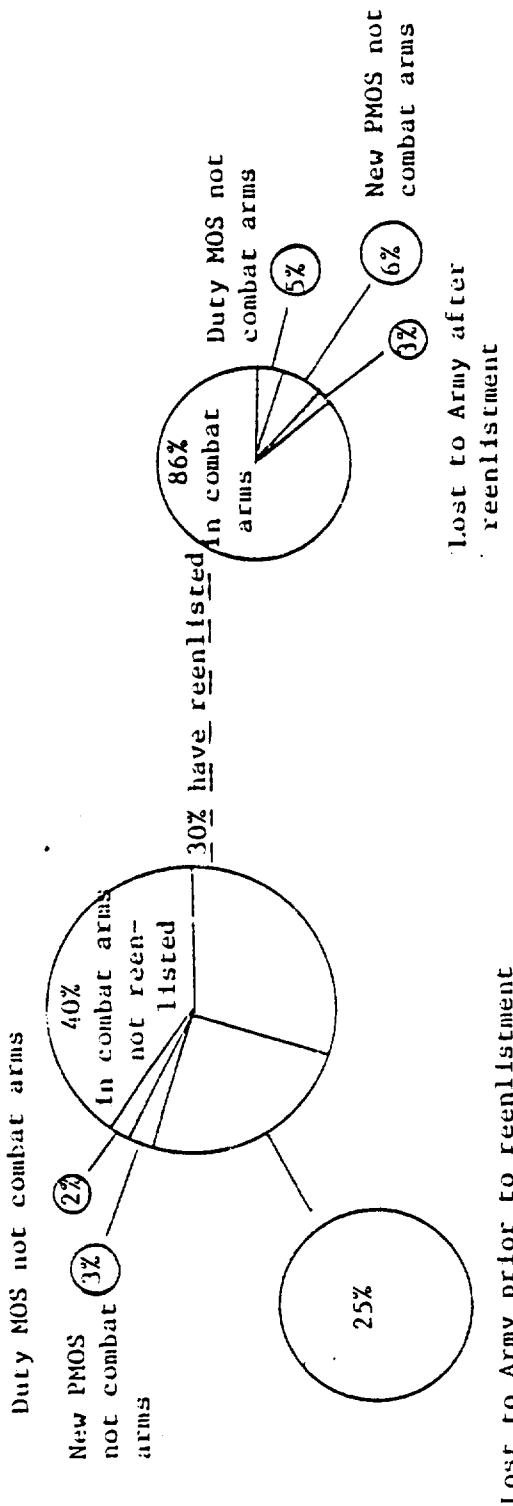


Fig. 26.—Status of Enlistedees with Combat Arms Options 30 Months After Enlistment
 High School Diploma Graduates,
 Four Year Enlistedees with Other than Europe Option

arms specialties. These adjusted service times are given in Table 22. Because of the higher PMOS and DMOS loss rates for the three year enlistees, the difference in expected service times in combat arms for four versus three year enlistees is greater than the differences in Table 17 for expected service times in the Army. The differences in Table 22 now range from .5 years for the Europe option to over .8 years for the CONUS options.

Table 22

EXPECTED SERVICE TIMES IN COMBAT ARMS
HIGH SCHOOL DIPLOMA GRADUATES
COMBAT ARMS ENLISTMENT OPTIONS

Option	3 year term	4 year term
Europe	2.32	2.82
CONUS	2.11	2.93
All	2.22	2.86

5. COST/EFFECTIVENESS CONSIDERATIONS IN THE EVALUATION OF ENLISTMENT BONUSES

OBJECTIVE

In this chapter some cost effectiveness measures for the evaluation of enlistment bonuses are defined and are applied to the results of the preceding chapters. The results are compared with cost effectiveness measures for some other programs designed to expand enlistments or enlisted man-years in the Army.

MEASURES OF EFFECTIVENESS

The enlistment bonuses have been offered to accomplish several related objectives. Most generally, the objective is simply stated as increasing the supply of enlistees to the Army in certain skills. In practice, more narrow objectives are pursued - to increase the supply of quality enlistees to the skills for which bonuses are offered. Aside from the \$1500 combat arms bonus offered from June 1972 to April 1973, the bonuses have been offered almost exclusively to mental group I-III high school graduates.

Since several recent studies have shown that the Army's supply of non-high school graduates is large relative to total accession requirements, it is appropriate to define measures of effectiveness for the various bonus, recruiting and advertising programs in terms of gains in higher quality accessions.

Enlistment bonuses do not, however, simply increase accessions to the Army in particular skills. The bonus is offered only for four year enlistment terms while most Army enlistments are for three years. As a result, gains in total man-years arise both from new enlistees and from

enlistees who would have enlisted without the bonus, but for a shorter term.

As shown in Chapters 3 and 4, the expected service time is less than the committed time and differences between three and four year enlistees are generally less than the full additional year committed.

These factors combined lead to two definitions of effectiveness for the bonus.

1. Bonus cost per additional expected service year, where both cost and effectiveness are restricted to the quality groups that are permitted to enlist in the bonus program.

2. Cost per useful service year which accounts for bonus, pay and variable training costs and divides total expected cost by the expected service time less training time. Algebraically, the cost per useful service year can be expressed as:

$$\text{Cost} = \frac{\left(\sum_{i=1}^{48} C_i M_i \right) + T_v + A + C_T B}{U} \quad (10)$$

where M_i is the average RMC pay for the i th month of service; T_v is the variable training cost with enlistee pay removed(reference 4); A is the sum of accession costs, estimated as \$1300 by the US Army Concepts Analysis Agency; C_T is the probability of continuing in the service to the point of bonus eligibility; and B is the bonus award level.

In this context, two separate measures will usually be required - gains to the service and gains to the bonus skill(s).

The first cost-effectiveness measure can be compared to a suitable measure for other accession programs. For recruiters, one can estimate the cost of an additional expected service year by determining the expected gain in three year enlistments per additional dollars spent on recruiters. A similar approach will also be used for print media advertising.

The second measure can be computed for three and four year enlistment terms to determine whether the bonus may be justified purely in terms of the gain in expected service from an enlistee who would have enlisted for three years without the bonus.

⁴Comptroller of the Army, Military Occupational Specialty Training Cost Handbook, May 1974.

COMBAT ARMS ENLISTMENT BONUS

Accession Gains to the Army

In Chapter 1, it was estimated that the \$1500 bonus increased the supply of mental group I-III high school graduates by 250 per month or 3 1/2 percent relative to current accession levels. In addition, it converted an additional 450 enlistees from three year to four year terms. About 700 enlistees per month accepted the bonus at an apparent total cost of \$1.050 million. This cost is reduced by 8 percent to account for those enlistees who leave the Army prior to becoming eligible to receive the bonus and becomes $.92 \times \$1.050 = \966 million per month. Current estimates of FY76 accessions of this quality group without the bonus⁵ are 5,550 per month and if these were all three year enlistees, the total expected service years (as defined in Chapter 3) would be approximately 15,485. With the \$1500 bonus the expected service years would be:

- o For 5,100 enlistees who continue as three year enlistees - 14,225
- o For 450 enlistees who switch from three to four year terms - 1,450
- o For 250 new enlistees with four year terms - 805

The total expected service years with the \$1500 bonus is 16,480, a gain of 995 over the no bonus case. The 995 years are gained at a cost of \$.966 million so that the cost per additional expected service year is \$970.

The \$2500 combat arms enlistment bonus causes about 110 three year enlistees to switch to four years but adds no new enlistees. The gain in expected service years (relative to the \$1500 bonus case) is 48 while the bonus cost rises to $810 \times \$2500 \times .92 = \$1,863$ million, an increase in cost of \$.897 million. On this basis, the cost per additional service year for the \$1,000 increase in the bonus is \$18,685.

These costs can be compared with estimates of cost per additional service year which would arise if the RMC pay, the number of recruiters or the advertising budget were increased. Using data from Table 6, Chapter 1 and reference 5, the cost per additional high school graduate expected service year for an increase in recruiters, with all additional enlistments being for three years would be \$2,040. For an increase in the advertising budget, the cost per additional expected service year is

⁵ General Research Corporation, "Recruiting Projections for the Armed Services" (Draft), December 1975.

estimated to be \$3,590. For an increase in RMC pay, the cost per additional expected service year is estimated to be \$32,500 (see reference 6, table 15). These results are summarized in Table 23.

Table 23

COST PER ADDITIONAL EXPECTED SERVICE YEAR IN THE ARMY
BY MENTAL GROUP I-III HIGH SCHOOL GRADUATES

Program	Cost per additional expected service year
\$1500 Combat Arms Bonus	\$ 970
\$1000 Increase in Combat Arms Enlistment Bonus	\$18,685
Increase in Number of Recruiters	\$ 2,040
Increase in Advertising Budget	\$ 3,590
Increase in RMC Pay (Increased pay only for Army)	\$32,500

As can be readily seen in Table 23, the effectiveness of attempting to increase mental group I-III high school graduate accessions by general increases in RMC pay is very doubtful, even when the assumption is made, as in Table 23, that only Army pay is increased. Since this is an unlikely occurrence, one ought to increase the stated cost per additional expected service year by a factor of about 3 to account for the cost of providing a pay raise to all members of the active services. The comparison between bonus and RMC pay effectiveness points up the relative attractiveness of increasing compensation selectively, and/or applying the increase in larger payments than would be perceived by the recipient if the increase were spread over a longer term payment schedule.

Accession Gains to Combat Arms

In Chapter 1 it was observed that the \$1500 bonus increased the apparent supply of enlistees to combat arms by 250 per month, but the actual number of high school graduate combat arms enlistees did not increase. For purposes of this analysis, the evaluation will be based on the apparent supply increase. Using methods similar to the preceding

⁶General Research Corporation, Analysis of FY75-FY80 POM Recruiting And Advertising Resources, August 1974.

section, the cost per additional expected service year in combat arms (using the modified expected service times in combat arms from Chapter 4) is estimated to be \$1135 for the \$1500 bonus and \$12,630 for the \$1000 increase in the bonus. Table 24 shows these results with the effects of RMC pay, recruiting and advertising increases on gains in combat arms.

Table 24
COST PER ADDITIONAL EXPECTED SERVICE YEAR IN COMBAT ARMS
BY MENTAL GROUP I-III HIGH SCHOOL GRADUATES

Program	Cost per additional expected service year
\$1500 Combat Arms Bonus	\$ 1,135
\$1000 Increase in Combat Arms Enlistment Bonus	\$ 12,630
Increase in Number of Recruiters	\$ 5,680
Increase in Advertising Budget	\$ 9,995
Increase in RMC Pay (Increased pay only for Army)	\$224,175

Table 25 shows the cost per useful service year as defined in equation (10) for the combat arms MOSs for three and four year enlistments. It can be seen that even the \$1500 bonus raises the cost per useful man-year for all but 13E which has the highest variable training cost and longest training time.

Combining these results, one infers that there is little justification for offering a bonus to combat arms enlistees simply to get an additional committed year. On the other hand, the marginal cost of obtaining additional service years, including the gain of new enlistees, is lower for the \$1500 bonus than for increases in recruiters or advertising.

Table 25
COMPARISON OF COSTS PER USEFUL SERVICE YEAR FOR THREE AND FOUR YEAR
ENLISTMENTS IN COMBAT ARMS SKILLS

Combat Arms MOS	Training time (years)	Variable* training cost	Cost per useful service year		
			3 year term	4 year \$1500 bonus	4 year \$2500 bonus
11B	.19	\$ 1,840	\$ 9,390	\$ 9,740	\$ 10,055
11C	.19	2,710	9,610	10,025	10,330
11D	.30	3,145	10,210	10,555	10,870
11E	.30	4,410	10,710	10,990	11,305
11F	.19	1,325	9,080	9,565	9,870
13B	.32	3,710	10,520	10,820	11,140
13E	.47	8,460	13,230	13,150**	13,485

* Excluding trainee pay.

** Cost per year for four year enlistment with \$1500 bonus is less than cost per year for three year enlistment.

NON COMBAT ARMS ENLISTMENT BONUS

Accession Gains to the Army

Using the results of Chapter 2 and Appendix 3, it is estimated that the monthly increase in expected service years arising from the enlistment bonuses offered to the mix of non-combat arms skills in the first half of FY75 was 895 and the estimated monthly bonus cost was \$757,800 (after adjustment for losses from the Army prior to receipt of the bonus), yielding a cost per additional expected service year of \$845.

Accession Gains to the Bonus Skills

Because both \$1500 and \$2500 bonuses were being offered to related skills during the test period, it is not possible to do any extensive analysis of the effectiveness of the \$1500 bonus. Nor is it possible to estimate what the results would have been if only \$1500 bonuses had been offered. It is possible, however, to estimate the gains in particular skills for which the \$2500 bonus was offered. In these cases, no data exists from Chapter 4, so in the following, expected service times from

Chapter 3 will be used. The analysis follows the same pattern as used for estimating the costs of gains to the combat arms skills. The results of this analysis for certain skills and groups of skills are given in Table 26. As is seen in the last line of Table 26, the \$2500 bonus increased mental group I-III high school graduate expected service years by more than 150 percent at a cost of \$800 per additional expected service year.

Table 27 shows a comparison of costs per useful service year for three versus four year enlistments for the MOSs offering \$2500 bonuses. As can be seen, there does seem to be an advantage to offering the bonus in those skills with high training costs and long training times, even when only switches from three to four year enlistments are considered.

Table 26
COST PER ADDITIONAL EXPECTED SERVICE YEAR IN THE BONUS SKILLS
BY MENTAL GROUP I-III HIGH SCHOOL GRADUATES \$2500 BONUS SKILLS

Skill or Skill Group	Expected Monthly Service Years No Bonus	Expected Monthly Service Years Bonus	Monthly Bonus Cost (\$000)*	Cost/Additional Expected Service Year
Combat Engineer	402	856	375.5	\$ 827
Artillery Crewman	68	284	158.3	733
Artillery and Missile Maintenance	30	73	40.5	940
Electro-Mechanical Maintenance Except Artillery & Missile	15	68	41.8	788
All \$2500 Bonus Skills	528	1352	658.5	799

* Adjusted for 8 percent pre-payment losses from the Army.

Table 27

COMPARISON OF COSTS PER USEFUL SERVICE YEAR FOR THREE AND FOUR
YEAR ENLISTMENTS FOR NON COMBAT ARMS SKILL OFFERING A \$2500 BONUS

MOS	Training Time	Variable* Training Cost	Cost per useful service year	
			3 year term	4 year term
12B	.30	1880	\$ 9,980	\$ 10,405
15E	.32	4290	11,030	11,280
16P	.32	4350	11,055	11,300
16R	.32	3435	10,685	10,995
22L	.89	9190	16,855	15,960 **
27D	.32	2410	10,275	10,650
27H	.47	4510	11,830	11,950
32E	.99	10350	18,420	17,510 **
35J	.55	5340	12,615	12,600 **
46N	.78	5210	13,980	13,695 **

* Trainee pay excluded.

** Cost per year for four year enlistment with \$2500 bonus is less than cost per year for three year enlistment.

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